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(71)(72) Applicants and Inventors: YUEN, Henry, C. [US/US]; P.O. Box 1159, Redondo Beach, CA 90278 (US). KWOH, Daniel, S. [US/US]; 3975 Hampstead Road, La Canada, Flintridge, CA 91011 (US).

(74) Agent: LEE, Simon, K.; Christie, Parker & Hale, 350 West Colorado Boulevard, Suite 500, Pasadena, CA 91109 (US).

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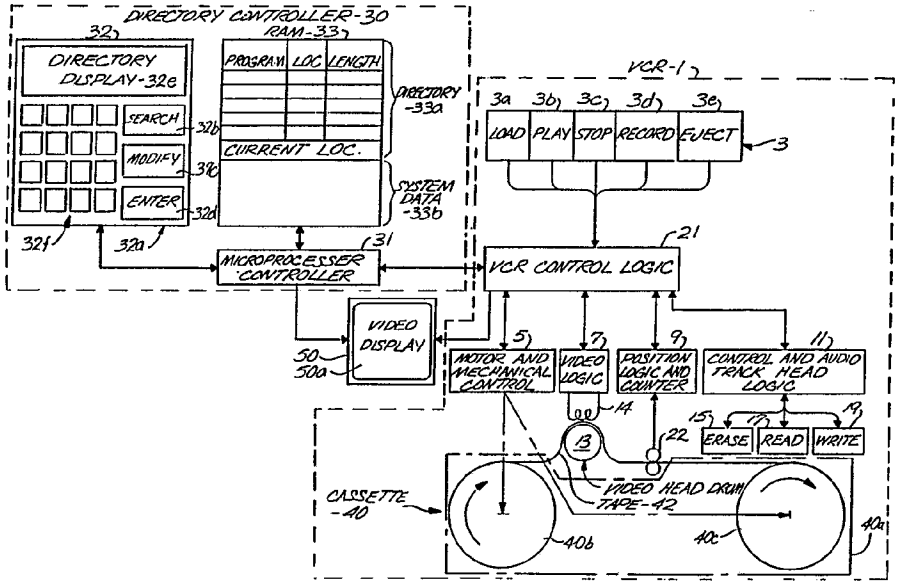

(57) Abstract

A directory of programs recorded on a cassette tape is provided to facilitate recording and reviewing of the programs and allocating and deallocating of space on the tape. The directory is either stored on the cassette tape itself or on an external memory. Designs of the various components for providing and maintaining the directory are also disclosed.

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PROGRAM DIRECTORY FOR A VIDEO TAPE CASSETTE

Background of the Invention

1. Field of the Invention

In one aspect, this invention relates to maintaining current information about a tape in a magnetic tape cassette and more particularly to maintaining current information about such a tape using a magnetic tape reader/recorder, and magnetic tape cassettes therefor. In another aspect, this invention relates to means and method for facilitating management, storage and retrieval of programs stored in a cassette of magnetic tape.

2. Related Art

Two general methods for long term mass storage of data are known; random access and sequential access. The random access method uses long playing (LP) record players, compact disc (CD) drives and video disc drives for consumer use, and hard disc drives, floppy disc drives and optical disc drives for use with computers. In all information is accessed in random by moving a playing head directly over the desired playing area of the stored media.

In the sequential method stored information can only be accessed sequentially. The sequential method uses audio tape drives, video tape drives and digital audio tape drives for general consumer use and digital tape drives and tape backup cassette drives for use with computers and analog tape drives for instrumentation purposes. All of these devices use magnetic tape as the stored media. The big advantage of tape drives is low cost compared with random access devices. The disadvantages and problems of using magnetic tape are three-fold.

1. To go to a particular location on tape, the tape must be either advanced or rewound in a serial or sequential manner. Even with fast forward or reverse, this is a time consuming process.

2. The exact contents and location of records on the tape are not known.

Random access devices can record (usually at the outermost tracks) an index of the content at the beginning of the disc and anytime the index information needs to be accessed, the read or write head simply skips over to and reads the index. For magnetic tape, even if the index is recorded in a reserved area at the beginning of the tape, as is presently done in some video tape, its usefulness is limited, due to the time required to rewind the tape all the way to the beginning of the tape, assuming the tape is not at the beginning when the need arises to search for the index. Owners of large numbers of tapes desire to place titles on the tapes to enable rapid identification of the program thereon. Usually titling is done by hand writing a title on a label on the tape or its box. However, the tape can become separated from the box, or the label may fall off. Some tape owners repeatedly record over the same tape and prefer not to use permanent labels. Computer tapes may contain hundreds of records or files and handwriting or updating the index onto the box is not practical.

3. The absolute location where the tape is being read or written usually is not known. Most tape drives have tape counters which only indicate relative location. For example, if a tape cassette is played and then removed from a tape drive without rewinding, the next time the cassette is inserted and played by a tape drive, the absolute location of the tape in the cassette will no longer be known. Attempts have been made to overcome this problem by writing absolute address marks onto the tape. For example, some recent video tapes use the VHS Address Search System (VASS) whereby absolute address marks are written at 1 minute intervals onto a control track of a VHS tape. In computer backup of hard discs by tape, the streaming mode is usually used, and where a constant stream of data blocks (usually 512 bytes) are written on tape, each block is usually preceded by one or two address bytes. Thus, absolute addressing is available but not yet universally used on tape.

Knowing the absolute address is important. For example, assume that there are 5 programs (or records) on a tape and each of their starting addresses is known and a user desires to go to the starting location of program 4. Without knowing the absolute address of where the tape is currently positioned for reading and writing, the user or the drive has no way to know whether to rewind or fast forward the tape to reach the desired record.

In order for tape drives to perform as well as random access devices it is important to overcome these three problems.

Placing a descriptive title on the tape presents another problem. Video titling is known and can be used to magnetically record alphanumeric information on a leader portion of the tape, which thereby serves as a title. Ordinarily, the title is computer-generated and recorded in a stream of regular video frames, rather than in a control track. If multiple copies of the tape are made, the quality of the title drops dramatically. Also, the title cannot

be conveniently edited without re-recording the stream of frames. Prior art systems for applying such titles are either expensive or cumbersome. Professional video titling systems include the well-known Chyron system and many others. Typically these systems include a complete computer, a complex, high-resolution character generator, a special effects generator for making shadows, italics and other effects, and a video interface to generate a video signal. Such systems are too expensive and complicated for the home video market.

Some videocassette recorders (VCRs) and camcorders are equipped with simple character generators for displaying simple block letters and numbers, either superimposed over a recorded video signal or recorded and mixed with the picture signal. A typical camcorder application is adding characters representing the recording date and time to a video signal as it is being recorded, thereby adding a "date stamp." In VCRs the character generator can be used to show programming information such as channel, date, and time on screen as the VCR is being programmed to record programs at a future date. However, currently there is no simple way to use the VCR character generator as a titling device.

Another problem with prior art titling systems is data input and editing. With Chyron systems, a full-size typewriter-style keyboard is used which is inappropriate for home use and slow for poor typists. Editing of a title is impractical with most home-generated titles, because the title is recorded as a video image on the tape. Thus, the prior art fails to provide a convenient means for generating, storing, and editing video titles for use with sequentially-stored magnetic tape. Users of home video equipment would likewise appreciate a system using internal character-generator hardware and VCR remote controls, thereby precluding the need for complex or expensive hardware to generate titles.

Well known in the art is encoding program captions in unused portions of the broadcast television signal, such as line 21, field 1 of the vertical blanking interval (VBI). Recently the Federal Communications Commission requested the television industry to develop specifications for providing program identification data in line 21, field 2 of the VBI. Industry has responded with "A Proposed Specification for Extended Data Services on Line 21 Field 2," published by Mitsubishi Electronics America, Inc., Oct. 17, 1991. However, no prior art devices enable decoding of program title data from the VBI for use in a magnetic tape directory.

Summary of the Invention

The invention provides, in a magnetic tape cassette reader/recorder, a method and apparatus for maintaining current information about a tape in a magnetic tape cassette using a store on the exterior of the magnetic tape cassette. The method generally comprises the

steps of reading the content of the store on the exterior of each cassette after commencement of the insertion of such cassette in the reader/recorder, and causing the store on the exterior of the inserted cassette to be updated with current information about the tape therein whenever such cassette is ejected from the reader/recorder. The store contains a program directory comprising a list of programs recorded on the tape in the cassette and the step of reading comprises the step of reading the directory from the store. Preferably the updating occurs upon ejection of such cassette from the reader/recorder, and the reading is performed while such cassette is being inserted into the cassette reader/recorder.

The availability of a program directory will greatly facilitate operation of tape reader/recorder devices such as VCRs. For example, with a program directory, a user can perform a speed erase operation on a taped program by simply indicating on the directory that the program can be over-written, or select from the directory a proper tape segment to record a new program without having to go through the tape to find the right spot. In brief, the availability of a program directory will greatly eliminate much of the frustration that has been felt for so long by so many users of tape devices such as VCRs.

Preferably each cassette has a housing with a magnetic recording medium thereon and the step of reading comprises reading from the magnetic medium, and the step of updating comprises writing the updated directory on the same magnetic medium. In the preferred embodiment a program title is received and decoded from a broadcast television signal. The program title is preferably decoded from data encoded in the vertical blanking interval of the broadcast television signal. In one embodiment the program title is decoded from line 21 of field 2 of the vertical blanking interval.

In the preferred embodiment the reader/recorder further comprises a sensor for reading the store, the sensor being carried by the reader/recorder, and wherein the step of reading comprises the step of reading the contents of the store as the cassette is moved past the sensor, and wherein the step of causing update comprises the step of writing the contents of the store as the cassette is moved past the sensor.

Preferably the store is formed as a magnetic strip affixed to the housing of a video cassette. The reader/recorder comprises at least one read/write head for reading from and writing to the strip responsive to movement of the strip relative to the at least one read/write head. The step of reading comprises reading the contents of the store with the read/write head as the cassette is being moved into the reader/recorder, and the step of updating comprises writing the current information into the store as the cassette is moved relative to the read/write head during ejection. The step of reading preferably comprises setting an internal tape position counter in the reader/recorder by storing the information in the counter.

The invention also provides, in a magnetic tape cassette comprising a magnetic tape movable between supply and take-up reels carried within a housing, the improvement comprising a storage medium in which information can be repeatedly read, written, and erased mounted on the exterior of the housing. The storage medium preferably comprises a magnetic layer and an adhesive layer for affixation of the storage medium to the housing.

In one embodiment, the present invention is a method and/or apparatus that uses a tape reader/recorder, and a controller with memory, for maintaining and making available a directory for a tape in a cassette. The directory has a representation of each of a plurality of records (which are typically programs or files) recorded on the tape and a representation of the position along the tape where each such record is recorded. The directory includes space to store digital data representing each title of each of the plurality of records. The cassette with the tape may be repeatedly inserted into, read by and then removed from the reader/recorder. The reader/recorder moves the tape within the cassette during reading and recording on the tape. The directory is read from the tape with the reader/recorder when the reader/recorder begins reading the tape after the cassette has been inserted for reading in the reader/recorder. The directory is stored in the memory for retention, update and display. The stored directory is recorded on the tape, prior to each removal of the cassette from the reader/recorder, adjacent the position on the tape at which the reader/recorder will commence reading of the tape when the cassette is reinserted in the reader/recorder.

In an alternate embodiment, entries are created in the directory in the memory. In each said entry, a representation is created of a different record on the tape, a representation of the position along the tape where such record is recorded, and a title of the record. Also preferably, a marker is formed on the tape to uniquely identify the position of a current directory. Also preferably, a first marker is recorded on tape in close proximity to a current directory when the directory is recorded on the tape. The tape is searched for a directory with the first marker. A second marker is recorded on the tape in close proximity to the first marker when the current directory is read. Alternatively, a marker may be recorded on the tape in close proximity to a current directory when the directory is recorded on the tape. The tape is searched for a current directory with the marker in close proximity thereto. The marker is erased when the directory is read. Also, the current tape position may be read from the housing of the cassette during insertion of the cassette into the reader/recorder. A current position of the tape may be written on the housing of the cassette during removal of the cassette from the reader/recorder.

In an alternate embodiment, a program title, forming one part of the directory, can be entered using controls on a jog shuttle remote control of the recorder/reader as an input

device. A representation of an alphanumeric keyboard is displayed on a monitor screen by a character generator in the recorder/reader under control of the controller. Arrow buttons or a jog shuttle knob on the remote control can be used to select individual characters forming words in the program title. After the complete title is composed by a user it is saved in the directory. In another embodiment, a scrollable character is displayed instead of a keyboard representation. The arrow buttons or jog shuttle knob cause the character to change by stepping sequentially through the alphabet until a desired character is located.

In another alternate embodiment, the controller is coupled to a broadcast television signal and to a decoder for decoding data from the VBI portion of a broadcast television signal. The decoded data is fed to the directory in the memory and also is displayed on a monitor screen. The displayed title and other data can then be edited using controls on a jog shuttle know of a VCR remote control. In one specifically contemplated embodiment, the decoder decodes data from line 21, field 2 of the VBI.

In one embodiment, the directory is erased from the tape immediately after the step of reading the directory. n a further embodiment, the reader/recorder repositions the tape in the cassette, after reading the directory and prior to removal of the cassette, to a position such that the directory will be read out by the reader/recorder upon reinsertion of the cassette in the reader/recorder and prior to reading by the reader/recorder of one of the records from the tape.

Preferably there is recorded on the tape in association with the directory, a current position of the tape at which the reader/recorder will commence reading the tape upon reinsertion of the cassette in the reader/recorder. Also preferably, when reading the directory from the tape, the current position is also read from the tape and a representation of the current position is stored in the memory. Preferably, the current position in the memory is updated as the tape is being moved for reading or writing and the updated position may be recorded on the tape.

One method or apparatus uses a VCR and a memory, for maintaining a directory on a tape in a cassette. The directory has a representation of each of a plurality of records recorded on the tape and a representation of the position along the tape where each such record is recorded. The cassette with tape may be repeatedly inserted into, read by and then removed from the VCR. The VCR moves the tape within the cassette during reading and recording on the tape. Entries are created in the directory in the memory. In each said entry there is created a representation of a different one of the records for the tape and a representation of the position along the tape for such record. The stored directory is recorded on the tape, prior to each removal of the cassette from the VCR, adjacent the position on the

tape at which the VCR will commence reading of the tape when the cassette is reinstated in the VCR.

Preferably, the directory is read from the tape with the reader/recorder when the reader/recorder begins the reading of the tape after the cassette has been inserted for reading in the reader/recorder. The directory read from the tape is stored in the memory for retention, update and display.

Still another embodiment of the invention uses a tape reader/recorder, a sensor and a memory, for maintaining and making available from the housing of a magnetic tape cassette a directory of the type discussed above. The cassette with the tape may be repeatedly inserted into, read by and then removed from the reader/recorder. The reader/recorder moves the tape within the cassette during reading and recording on the tape. The directory is read from a storage medium on the cassette with the sensor during insertion of the cassette into the reader/recorder. The directory is stored in the memory for retention, update and display. The stored directory is recorded onto the memory cassette during removal of the cassette from the reader/recorder.

Preferably the tape is rewound in the cassette until the position of the tape relative to a beginning of the tape can be ascertained and then the tape is wound in the cassette from the ascertained tape position until the position of a desired program indicated in the directory has been reached. Also preferably the content of the directory in the memory is modified to reflect modification of the records recorded on the tape.

Additionally, a visible display of both the stored directory and the stored current position may be formed in any of the embodiments.

In another aspect, this invention discloses a video cassette recorder having not only a first data retrieval mechanism for retrieving data from the tape, but also a second data retrieval mechanism for retrieving directory information of the tape from a second memory.

Brief Description of the Drawings

Fig. 1 is a block diagram of a video cassette recorder with a directory controller and embodies the present invention;

Figs. 2A and 2B are flow charts illustrating the sequence of operation for updating and using the directory during loading and ejecting of a video tape cassette in the video cassette recorder of Fig. 1;

Fig. 3 is a graphical representation of the format of the information recorded on the magnetic tape in the cassette of Fig. 1 with markers and directories in the control track;

Fig. 4 is a graphical representation of the format of the information recorded on the magnetic tape in the cassette of Fig. 1 with markers in the control track and the directories in the fields of the video frames;

Fig. 5, composed of FigS. 5A, 5B, 5C and 5D, is a graphical representation of the format of information recorded on the magnetic tape at different stages of operation in the embodiment of the invention depicted in Fig. 1 using 2 markers;

Fig. 6, composed of FigS. 6A, 6B, 6C and 6D, is a graphical representation of the format of information recorded on the magnetic tape at different stages of operation in the embodiment of the inventions depicted in Fig. 1 using one marker;

Fig. 7 is a block diagram of a video cassette recorder with a directory controller and a magnetic write and sensing system for information recorded on the back wall of the cassette and depicts an alternate embodiment of the present invention;

Fig. 8 is a schematic and pictorial view of a video cassette recorder having a front load for the magnetic tape cassette in which the recorder has a reader and writer for a directory and/or directory locations on a magnetic strip along the edge of the magnetic tape cassette;

Fig. 9 is a schematic and pictorial view of a video cassette recorder having a top load for a magnetic tape cassette in which the recorder has a reader and writer for a directory and/or directory locations on a magnetic strip along the edge of the magnetic tape cassette;

Fig. 10 is a flow chart which in combination with the flow chart of Fig. 2B illustrates the sequence of operation of the video cassette recorder of Fig. 7 in which the magnetic strip at the edge of the tape cassette contains the location of the latest directory;

Fig. 11A and 11B are flow charts illustrating the sequence of operation of the video cassette recorder of Fig. 7 during loading and ejecting a video tape cassette in the video cassette recorder in which the magnetic strip at the edge of the tape cassette contains the latest directory;

Fig. 12 is a block diagram of the recorder of Fig. 1 also showing title generation components;

Fig. 13 is a diagram of a jog shuttle remote control for the recorder of Fig. 12;

Fig. 14A is a flow diagram of a keyboard character entry titling method;

Fig. 14B is a flow diagram of a cursor position updating method used with the method of Fig. 14A;

Fig. 14C is a diagram of a keyboard-mode title display;

Fig. 15A is a flow diagram of a scrolling character entry titling method;

Fig. 15B is a diagram of a scroll-mode title display; Fig. 16 is a perspective view of a videocassette; and

Fig. 17 is a diagram of a stack of adhesive-backed magnetic strips.

Figs. 18A and 18B are flow charts illustrating the sequence of operation for a video cassette recorder having additional features according to the present invention.

Fig. 19A is a timing chart of the clock signals prerecorded on the control track of a magnetic strip for synchronizing a reading operation.

Fig. 19B shows the signals recorded on the data track of a magnetic strip for allowing read/write operations to be performed in opposite directions.

Fig. 19C shows the output from a data track in an ideal situation.

Fig. 20A is a flow chart illustrating the logic sequence of a write operation to a magnetic strip.

Fig. 20B is a flow chart illustrating the logic sequence of a calibration operation for compensating misalignment of magnetic heads.

Fig. 20C is a flow chart illustrating the logic sequence of a read operation on a magnetic strip.

Fig. 21 shows schematically a memory comprising a magnetic strip for storing directory information.

Fig. 22 shows a magnetic strip attached to the top of a cassette and also a mark provided on the magnetic strip.

Fig. 23 shows two magnetic strips attached to the back wall of a cassette.

Figs. 24A to 24G are flow charts illustrating user interface and operation of a controller according to the embodiment of the present invention.

Figs. 25A and 25B are different views of a magnetic write/sensor head unit for reading a magnetic strip.

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Detailed Description

Fig. 1 is a block diagram of a magnetic tape indexing system including a video cassette reader/recorder (VCR) 1 with a conventional video tape cassette 40, a video display 50, and a directory controller 30 including a microprocessor controller 31, a random access memory (RAM) 33 and a directory input/output keyboard and display device 32.

The VCR 1 is a conventional video reader/recorder device and uses any one of many different recording technologies such as BETA VHS, super VHS, 8 mm or any other popular technologies. The technology and operation of a VCR are well understood in the art.

The VCR 1 has a button control panel 3 with control buttons including LOAD 3a, PLAY 3b, STOP 3c, RECORD 3d, EJECT 3e for controlling the operation of the VCR. The LOAD button is optional and is not used on machines which load automatically. VCR control logic 21 receives control signals from the button control panel 3 and controls the overall operation of the VCR by sending control signals to motor and mechanical control logic 5, video logic 7, position logic and counter 9, and control and audio track head logic 11 of the VCR 1, as well as to the video display 50 and microprocessor controller 31 of the directory controller 30.

The motor and mechanical control logic 5 controls loading and ejecting of the cassette 40 and also controls video tape 42 movement within video cassette 40 during recording and reading (playback). The video logic 7 controls the operation of video read/write head drum 13 in reading from or recording video signals to tape 42. The electrical signals are magnetically coupled between the video logic 7 and the video head drum 13 using a transformer 14. The position logic and counter 9 monitors tape movement through cassette tape movement sensor 22 and converts the signals into signals that represent tape position. The control and audio track head logic 11 controls writing, reading and erasing of signals on the control or audio track of tape 42 through the write head 19, the read head 17 and the erase head 15.

Cassette 40 is a conventional video cassette having magnetic tape 42 packaged in a cartridge or cassette (hereafter called cassette) housing. Even though the size and design of the housing is different for different types of recording technology, the basic information that goes on the tape itself is similar.

FigS. 3 and 4 illustrate the information content of one example of video tape for both BETA and VHS format. The tape is divided into three areas. A narrow strip running along the upper edge of the tape is an audio track 42a which contains audio signals. A second narrow strip running along the bottom edge of the tape is a control track 42c which contains synchronization ("sync") control signals. The middle area 42b is for video signals which are

recorded in pairs of parallel fields going up and down the width of the tape at a slight angle. As is well known in the art, each of the video frames 42b consists of two fields, variously known as fields A and B, or fields 1 and 2. In the NTSC protocol widely used in North America, each field contains 262.5 horizontal lines and a pair of fields constitute a single 525 line video frame and creates one video picture at one instant in time on the video display 50. The video head drum 13 is fitted with two read/record heads 180 degrees apart, so that even numbered lines make up one field and odd numbered lines make up the other field. To reduce flicker on the video screen, these fields are projected onto the face of the cathode ray tube (CRT) screen 50a of video display 50 at alternating intervals. The VCR control logic 21 begins with the field containing the odd-numbered lines by scanning the odd lines on the CRT from left to right and top to bottom. As soon as this is completed, the beam is quickly returned to the top of the screen and the even-lines are scanned onto the screen. As the beam is returned to the top a brief delay occurs, called the VBI. Apparatus and methods using these techniques are well known in the art and therefore are not discussed in detail herein.

A program directory or directories containing information about the names and locations of each program or record on the tape is stored on the tape. Either the video frames 42b or control track 42c may be used for storing the program directory(s). In one embodiment the program directory is stored, by VCR control logic 21 under control of microprocessor controller 31, in the control track 42c and in another embodiment in odd or even numbered fields of spaced apart pairs of video fields.

In one implementation, the tape contains only one single valid directory and a plurality of obsolete directories corresponding to the number of times the tape has been played and ejected from the VCR. The valid directory is distinguished from the obsolete directories by a marker system to be described later. In another embodiment each time the directory is read into the local RAM memory, the directory is erased from the tape. During the process of tape ejection from the VCR, the updated directory is rewritten onto the tape at the place of ejection such that only one directory is maintained on the tape. The disadvantage of this embodiment is the added hardware and time required to selectively erase the directory without disrupting the control or video signals. If the directory or directories are stored in the video fields, corruption of video signals with directory signals on selected video fields, such as a few odd fields spaced apart by a certain number of fields, has little noticeable visual degradation of the video picture. This is because the human brain retains a visual image for a brief period after the image is removed ("persistence of vision"). If the directories are stored in the control track, it is done in such a way that the control sync pulses (not shown) necessary for synchronization of video displays are not disturbed.

The VBI portion can also be used for providing address marks on the tape to facilitate management, storage and retrieval of recorded programs and the tape. In one implementation, when a cassette of tape is inserted for the first time into a recorder embodying this invention, it is rewound to the beginning, and the tape counter is then reset to zero. When a VBI is encountered during the recording of a program, the value of the tape counter is registered. This tape counter value is then written in one of the free spaces (such as line 20) among the VBI portion of the broadcast signals.

The tape counter value can be written on the control track as in the VHS Address Search System (VASS). Alternatively, according to one aspect of this invention, it can be written onto the video frame 42b (see FigS. 3, 4); and the VBI decoder 400 can thereby be advantageously used to both decode the program name and the address mark.

Directory controller 30 includes microprocessor controller 31, RAM 33 and a directory input/output display and control panel 32. Preferably the microprocessor controller 31 comprises an integrated circuit microprocessor and a program store, such as a read-only-memory (ROM), for storing a control program to implement methods of the invention. The directory input/output display and control panel 32 has alphanumeric keyboard 32a with special function keys SEARCH 32b, MODIFY 32c, ENTER 32d for entering program directory information.

Display 32e is a conventional liquid crystal or other type display for displaying data being entered on keyboard 32a, and to display the directory stored in the RAM 33. Alternately, as discussed below, an on-screen display 50a can be used. The directory information stored in the RAM 33 is processed by the microprocessor controller 31.

The RAM 33 is a conventional random access semiconductor memory which interfaces directly with the microprocessor controller 31. A portion of the RAM is reserved for storing the program directory 33a read from the tape at loading time and the rest for use by the microprocessor controller's system software as shown at 33b. For each record or program already on or to be recorded on the video tape, the directory in RAM 33 contains a corresponding entry. Each entry has a title or program name (PROGRAM), a location value (LOC) indicating the absolute position (or the value of the address mark) of the beginning of the program along the tape, and an optional length value (LENGTH) indicating the program's length in time units. The length of a program or record may be represented as a function of the difference between its address mark from the address mark of the next program or record. The last item in the directory is the current tape location (CURRENT LOC) indicating the absolute position from the beginning of the tape in the cassette where the valid directory is

located. Each item in the directory can be modified through the use of the buttons on keyboard 32a of directory controller 32.

The microprocessor controller 31, using system software residing in the RAM memory 33, controls the sequence and operation of the directory controller 30 and interfaces with the VCR control logic 21 to implement the necessary functional capabilities for reading, updating and recording the directory.

Consider briefly the operation of the system of Fig. 1 with the directory stored in the control tracks of the tape. Assume that cassette 40 has a directory recorded in the control track at the beginning of the tape, or at some point along the tape, and which has not been moved in its case since its last ejection is inserted into the VCR. The microprocessor controller 31 and VCR control logic 21 cause the directory to be read from the control track of the tape with read head 17 and stored into the directory field 33a of RAM 33. Optionally, the directory is erased from the tape after reading with erase head 15. The VCR counter is reset to a value corresponding to the CURRENT LOC value found in the directory. The tape is now ready to be read or recorded over in the usual manner. While the cassette is in the VCR, the copy of the directory that is stored in the RAM can be deleted, modified or updated.

When the eject button 3e is activated, microprocessor controller 3, and VCR control logic 3 causes the current tape location (CURRENT LOC) in RAM 33 to be updated with the tape counter value in position logic and counter 9 and causes the directory in the RAM to be recorded onto the tape at its current position and then causes the tape to be slightly rewound to the beginning of where the directory was recorded on the tape, and then causes motor and mechanical control 5 to physically eject the cassette 40.

When a blank cassette tape is loaded or when the user wants to modify or create a program directory, the directory controller 30 prompts the user at the display 32e or the video display 50 for desired input. The microprocessor controller 31 then formulates the input to the required format for storage into the RAM directory 33a for recording onto the tape when the tape is ejected.

In the event that the tape has been moved either forward or backward in the cassette from its last ejection position without subjecting the tape to the directory read/write process (such as when the tape is used in a VCR without the present invention), a number of methods may be used to locate the directory. Where only one directory is stored on the tape, such as where the directory is promptly erased after being copied into the RAM memory, one method is to rewind the tape all the way to the beginning of tape (BOT) and then perform a quick search to detect and locate the directory. Alternatively a marker is written in the control

track in close proximity to the directory, whether the directory is recorded in the video fields or in the control track, and is detected during searching to detect the location of the directory as this facilitates searching for the directory. Searching and interpreting data in the control track is much faster than doing so in the video fields. Fig. 3 depicts the marker 110 adjacent directory 112 in control track 42C whereas Fig. 4 depicts the marker 114 in control track 42C adjacent the directory 116 in the fields of the video frames 42B as shown in Figs. 3 and 4.

If there is more than one directory stored on the tape and only one is the current directory, two different methods may be used. The first method is depicted in Fig. 5. In this method, a marker 118 is recorded in the control track 42C in close proximity to the directory 120, when it is first written during the process of ejecting the tape from the VCR (whether in the control track or in the video field) as illustrated in Fig. 5. When the directory 120 is subsequently read and copied into the RAM memory, a second marker 122 is recorded next to the first marker 118 as shown in Fig. 5B. When the cassette is then ejected after playing or recording, a new directory 124 is then written at a different position on the tape along with a single marker 126 as in Fig. 5C. As a result, if the position of the tape in the cassette has been moved, as indicated by the dashed lines for read/write heads 17, 19 in Fig. 5D, the system merely looks for a directory 124 with a single marker 126, preferably in a high speed search made to reduce access time. When the located directory 124 is subsequently read, a second marker (not shown) is recorded adjacent marker 126 as described above.

Alternatively, as depicted in Fig. 6 a marker 130 is recorded on the control track 42C next to directory 132 whenever a new directory is created as shown in Fig. 6A. But, unlike the previous method, when the directory 132 is searched and copied into the RAM, the marker 130 is erased as shown in Fig. 6B. When a second new directory 134 is created, a marker 136 is recorded as in Fig. 6C. So even though there is more than one directory on the tape, and the tape has been moved in the cassette as indicated by the dashed illustration of the read/write heads 17, 19 in Fig. 6D, only the current directory 134 has a marker 136 associated with it for detection and location of such current directory.

To be discussed, in the embodiment of the invention depicted in Fig. 7, the location on the tape of the valid directory (i.e. the location of the tape at the point of ejection) is recorded on a store or a storage medium, for example a magnetic strip 150. Since the mechanism for raising and lowering a cassette is on the sides of the opening; therefore, the magnetic strip would be affixed either to the top or to the back of the tape cassette 40, and the data (i.e. the location of the tape) is recorded by a magnetic write/sensor head 154 using

the physical movement of the cassette load/eject drive mechanism to cause changes in magnetic flux detectable by the magnetic write/sensor head 154. Load/eject drive mechanisms are well known in the art as they are part of most VCRs. The physical cassette movement typically involves a horizontal movement and a vertical movement for a VCR using either front loading or top loading as shown in Figs. 4 and 5, respectively. When the tape cassette is inserted into the VCR, the magnetic write/sensor head 154 reads off the location information from the magnetic strip to allow easy searching and locating of the valid directory.

Alternatively, the entire directory can be written on the magnetic strip upon ejection and can be read off during insertion by the magnetic write/sensor head 154 using the magnetic flux changes caused by the physical movement of the cassette past the head.

Fig. 8 is a pictorial view of a video cassette recorder having a front load mechanism for the tape cassette 42. The recorder 1 has located therein a stationary magnetic read/write head 154 designed to read from and record on the magnetic strip 150 as the cassette 42 is inserted and ejected, respectively.

Fig. 9 is a pictorial view of a video cassette recorder having a top load mechanism for the cassette 42. A stationary magnetic read/write head 154 is positioned in the recorder 154 to read from and record on the magnetic strip 150 as the cassette 42 is respectively lowered into and ejected from the recorder.

Figs. 25A and 25B are different views of a magnetic read/sensor head unit 2500 implemented for reading data from and writing data to a magnetic strip.

The magnetic write/sensor head unit 2500 comprises a magnetic read/sensor head 2501 pivotally mounted on an arm 2502. The head 2501 has guides 2503, such as U-shape guides, for confining a magnetic strip 2506 beneath it as the magnetic strip 2506 passes under.

The arm 2502 has means, such as a ball-point finger 2506, for engaging to a guide, such as a groove, which guides the head 2501 along over the magnetic strip 2506.

The arm 2502 is mounted to a member 2508 by a pivot 2510 which gives it a freedom of vertical movement. The member 2508 is in turn mounted to a cantilever 2509 by another pivot 2511 which gives it a freedom of horizontal movement to adjust for the small displacement of the tape 2506. The head 2501 is mounted onto the arm by a pivot 2516 to provide azimuth alignment, that is, to enable the head 2501 to move in parallel with the tape 2506 even when the arm 2502 shifts in adjusting for a displaced tape.

A lift cam 2512 is pivoting mounted to the member 2508, one arm 2513 of the cam 2512 is coupled by a spring 2514 to the cantilever 2509. In the absence of a cassette, the spring 2514 pulls the arm 2513 of the cam 2512 up, thereby lifting the head 2501. When a

cassette is inserted, it pushes the other arm 2515 of the cam 2512, thereby lowering arm 2513 and allowing the head 2501 to drop onto the magnetic strip on the cassette.

A variety of other mechanical configurations and locations for the head 154 and the strip 150 may be employed to accommodate various tape cassette transport mechanisms. By way of example, head 154 can be made movable and programmed using a suitable transport mechanism (not shown) to scan across the surface of a stationary strip 150 when the cassette 42 is in the recorder 1, for reading or writing information from/to the strip 150.

One advantage of a movable head is that the strip 150 can be updated with the information from the RAM 33 without requiring a movement of the cassette and can therefore be performed more frequently, such as at each time when the directory 33a is updated, so that the directory information can be preserved even when power to the recorder is lost before the cassette is ejected.

For a stationary magnetic head, the length of the magnetic strip 150 that can be used for storing information is limited by the distance of movement of the cassette when it is ejected and inserted. Since data storage and retrieval for a movable head do not require movement of the cassette, therefore, another advantage of a movable head system is that the length of the magnetic strip 150 can be longer.

Details of the strip 150 and affixing strips to videocassettes are shown in Figs. 16 and 17. As shown in Fig. 16, a standard videocassette 42, such as a VHS type videocassette, comprises a housing 42' having top and bottom walls 200, 202 and four side walls 204, 206, 208, 210. Usually the housing 42' is constructed as a relatively flat parallelpiped wherein the vertical separation of top and bottom walls 200, 202 is much less than the width or length of the top or bottom walls. The magnetic strip 150 (not shown in Fig. 16) can be placed in an affixation zone 151 on the back wall of the housing, or on the top of the housing.

Magnetic strips 150 can be manufactured and distributed in stacks 149 as shown in Fig. 17 or in rolls or sheets (not shown) cut to size by the user. Each strip 150 comprises a magnetic recording layer 152 and an adhesive layer 156 for affixation to the zone 151. The magnetic layer 152 is, by way of example, constructed of the same materials as the magnetic tape 42 and may be affixed to any standard tape cassette by the user or pre-attached by the cassette manufacturer. A strip of video tape approximately one-half inch in length and one-half inch wide can be used as layer 152 in the configurations of Figs. 8 and 9 to store approximately 4 kilobits of coded digital data. The adhesive layer 156 is applied to the non-magnetic backing of the magnetic layer 152. The adhesive can comprise a pressure-sensitive adhesive, or any of a variety of natural or synthetic organic adhesives suitable for bonding magnetic tape to the housing of a videocassette. In an alternative embodiment, strips 150 are

formed with double-backed tape self-adhesion to zone 151. Thus, the strips 150 can be affixed to any standard cassette, thereby enabling an owner of cassettes to add directory storage capability to any existing cassette.

Fig. 21 shows another implementation of the magnetic strip. The magnetic strip 2101 according to this implementation is attached to a base, such as a card 2102. The card 2102 preferably has a depressed area 2103 in which the magnetic strip 2101 is placed.

A strip of resilient material (not shown) is placed between the card 2101 and the magnetic strip 2101 to improve its contact with a magnetic write/sensor head. A guide, such as a groove 2104, is provided on the card 2101 to guide a magnetic write/sensor head to ensure that it moves over the magnetic strip in a read/write operation. The groove 2104 will be used to engage a pin on the magnetic head. Also, each end of the groove may be widened to assist the pin of a magnetic head to engage to the groove 2104. On the other side of the card, adhesive substance is provided for adhering the card to the cassette. A sliding cover (not shown) may optionally be provided to protect the magnetic tape.

The card 2101 according to this implementation can be placed on the top of the cassette in a recess 2105 as shown in Fig. 22 to reduce its exposure and the exposure of the magnetic strip.

Alternatively, the card with the magnetic strip may be place on the back of the cassette casing as shown Fig. 23, and preferably in a recess thereon. If the thickness of the cassette is not long enough, then the magnetic strip can be divided into two portions, 2302 and 2303, to be read with two magnetic heads. The card for carrying the magnetic strip is depicted in Fig. 23 as 2301.

As depicted in Figs. 21 and 22, the magnetic tape has a mark 2101 which provided for informing the controller that a directory embodying the present invention is available so that appropriate functions can be performed. The mark 2101 may, for example, be created with light reactive material (e.g. reflective material) so that it is recognizable by a device in the recorder (or as part of the magnetic write/sensor head) when light from a source, such as a light emitting diode or a laser is projected thereon.

To facilitate its use with a stationary magnetic head, the magnetic strip 150 has two parallel tracks of magnetizable material. The first track is a control track pre-recorded with uniformly-spaced clock signals as illustrated in Fig. 19A. These clock signals are provided for synchronizing read/write operations of data to the second data track. The rising and falling edges of the clock signals indicate the boundary of cells.

According to the preferred embodiment, the data is recorded on the second track using the modified non-return-to-zero (NRZ-M) method. Under this method, a bit "0" is

represented by a no-change in magnetic field on the second track within two consecutive transitions on magnetic field on the control track; and a bit "1" is represented by a change in magnetic field within two consecutive transitions of magnetic field on the control track as can be seen in Fig. 19B.

The flow chart in Fig. 20A illustrates generally the logic sequence of a write operation.

The write operation is controlled by a read/write circuit which may reside either in the directory controller 30, as shown in Fig. 7, or separately (not shown) within the VCR 17. It can be implemented either by hard wired circuit or by software. Detailed description of the read/write circuit, however, is deemed unnecessary as it is well known in the art.

In step 2001, the read/write circuit waits for a transition on the control track to occur. Upon encountering the first transition, the read/write circuit enters step 2002, in which it resets and starts a timer.

In step 2003, the read/write circuit waits for the next transition on the control track to occur. When a transition occurs, the value of the timer is registered and then restarted (step 2004). In step 2005, the read/write circuit delays for a time period equals to half the timer value registered in step 2004.

Steps 2004 and 2005 are performed for the benefit of read operations, so that data can be sampled at time instances where the magnitude of the magnetic field is at peak values, as shown in Fig. 19C. These two steps can be omitted if appropriate actions are performed during the read operations.

In step 2006, the data bit to be output is examined, if the output bit is a "1", a signal is sent to the write/sensor head to change the magnetic field on the data track (step 2007). If the output bit is a "0", step 2007 is omitted.

In step 2008, the read/write circuit determines whether the write operation is completed. Step 2003 will be performed again if there are data left.

The read/write head unit 154 actually comprises a first magnetic write/sensor head for reading the control track and a second magnetic write/sensor head for reading the data track. The first magnetic write/sensor head, responsive to changes in magnetic field along the control track, generates clock pulses for sampling the signals received from the second magnetic write/sensor head.

As previously described, for a stationary head, data are written into the magnetic strip 150 when it travels in one direction and read when it travels in the reverse direction.

To facilitate the read and write operations to be performed in opposite directions, the data to be written into the data track of the magnetic strip 150 is preceded by a header 1901

as shown in Fig. 19B. The header 1901 is provided to synchronize the read/write circuit to the clock signals on the control track. The header 1901 according to the preferred embodiment contains 24 bits of "1". Behind the header 1901 is a mark 1902 provided to indicate that whatever is read from the data track in the next clock cycle is a valid data bit. According to the preferred embodiment, the mark 1902 contains 6 "0" bits followed by 2 "1" bits. This bit pattern is chosen because it is not used to represent data. It will be understood that other bit patterns can be used.

As write operations are performed in a reverse direction, mirror images 1902', 1901' of the mark 1902 and header 1901 respectively are written at the end of the data field 1903 as shown in Fig. 20. In addition, a parity byte 1904 is provided after the data field 1904 so that the direction of the magnetic field at each end can be determined.

Fig. 19C illustrates the output from the second magnetic write/sensor head in reading the bit pattern of Fig. 19B. Ideally, the second magnetic write/sensor head should sample the data track at the mid point of two consecutive transitions on the control track. Unfortunately, there is a possibility that magnetic strip 150 is read by a first and second magnetic heads which are misaligned with respect to one another, or that the data track was written by a different recorder whose first and second magnetic heads are aligned differently from those reading the strip, with the result that the data track is not sampled at the proper time instance.

To compensate for a possible misalignment between the two magnetic write/sensor heads, a calibration is performed when the header is read.

With reference to the flow chart in Fig. 20B, the read/write circuit waits in step 2010 for the initiation of a read or a write operation. When a first transition at the control track is detected (step 2011), the read/write circuit resets and then starts a timer. In steps 2012 and 2013, the read/write circuit continues to sample the data track until a transition on the control track is detected.

As the field in the data track is formed by a series of "1" bits, a transition on the data track should occur within the two consecutive transitions on the control track. When a transition on the data track is detected, the time lag, Tl, between the first transition on the control track and the transition on the data track is measured. The control track is continuously read until the next transition is detected. The time difference, Tc, between the first and second transitions is calculated (step 2014).

For better accuracy, steps 2012-2014 can be repeated for N times so that average values of Tl and Tc can be obtained. A calibration value, which equals to Tl/Tc, is calculated.

Fig. 20C illustrates the logic sequence for a read operation of the magnetic strip 150. In step 2020, the read/write circuit waits for detection of a transition on the control track.

When a transition is detected, the read/write circuit enters step 2021 in which it resets and starts a timer. In step 2022, the read/write circuit waits for the occurrence of another transition on the control track. When such a transition is detected, the timer is read and then reset, and the time difference, Tr, between the two consecutive transitions on the control track is calculated (step 2023). In step 2024, the read/write circuit waits for a delay so that the data track can be sampled at peak value. If steps 2004 and 2005 of the write operation of Fig. 20A are performed, the delay is Tr*(Tl/Tc). If steps 2004 and 2005 in the write operation are not performed, the delay is (Tr/2)+Tr(Tl/Tc).

At the end of the delay, the output from the data head is sampled (step 2026). If the output from the data head is the same as its value in the last clock (step 2027), a "0" bit is output (step 2028). Otherwise, if the output from the data head is changed, an "1" bit is output (step 2029).

In a further alternate embodiment, a thin erasable programmable read-only-memory (EPROM), or an electrically alterable read-only-memory (EAROM), can be placed on the exterior of the cassette at zone 151.

Consider now the details of the operation of the system of Fig. 1 in more detail with reference to the method of Figs. 2A and 2B. Assume the single directory marker technique of Fig. 5 is used, a directory is stored in the control track of the tape and that the tape is a prerecorded tape with a directory recorded at the point of last ejection and a number of video programs (or records) pre-recorded on the tape.

During block S1, the cassette 40 is inserted into the VCR. The VCR loads and mounts the cassette so that tape 42 and the video head drum 13, the tape movement sensor 31, and the read/write/erase heads 15, 17, and 19 of the audio and control tracks are all in proper place with respect to the tape 42 just before the directory at an original position.

During block S2, the microprocessor controller 31 causes the VCR to erase the contents of the RAM directory 33a in the RAM memory 33.

During block S3, the microprocessor controller 31, through the VCR control logic 21, enables the motor and mechanical control 5 to start rotating the tape reels 40b and 40c and hence move tape 42 in a forward direction. The microprocessor controller 31 and VCR control logic 21 also cause control and audio track head logic 11 to cause the read head 12 to read the directory from the control track if the directory is there. If the directory is not adjacent the read/write heads at the point of insertion (such as if the tape has been moved in the cassette case), then during block S3A, the microprocessor controller 31, through the VCR

control logic 21 and motor and mechanical control 5, causes the tape 42 to be rewound to the BOT and fast searching the control track for a single marker. If the marker is not found when end of tape (EOT) is encountered, then the microprocessor controller 31 causes a blank directory to be displayed either in the directory display 32e of the directory controller 30 or in the video display 50. On the other hand, if the directory is found as in this case, during block S4, the directory is read into RAM 33. The marker is erased during block S5. As an alternative, both the directory and the associated mark may be erased from the tape during block S5.

During block S6, microprocessor controller 31 causes logic 21 and control 5 to rewind the tape so that read/write heads 17, 19 are just before the directory. During block S7, the CURRENT LOC value from the directory is used to set the tape counter in the position logic and counter 9. During block S8, the directory is displayed by display 32 or by the video display 50 for user viewing, editing or input. The method now enters block S9 (Fig. 2D) and awaits further user instruction. If the PLAY button 3b is activated by the user, processing continues in block S18. During block S19, the VCR records or reads, i.e., plays tape and displays video images on the video screen 50a. If instead the STOP button 3c is activated, then in block S22 the microprocessor 31 causes logic 21 and control 5 to stop the tape. The tape does not necessarily stop at the end or beginning of a program.

Block S24 is reached from block 59 when the EJECT button 3e is activated by the user. During block S25, the microprocessor controller 31 ascertains whether a directory 33 exists in RAM 33. If a directory is not in the RAM, then block S30 is processed causing the cassette 40 to be ejected without writing a directory onto the tape. This occurs when the tape has no directory and the user does not create one or the user deleted the directory from the RAM through the input/output device 32.

Assume a directory exists in RAM 33. In block S26 the microprocessor controller 31 causes the CURRENT LOC value in RAM 33 to be updated with the current tape location value in position logic and counter 9. During blocks 27 and 28 microprocessor 31 causes the logic 21 and control 5 to start moving the tape in a forward direction. During block S27, the microprocessor controller 31 causes logic 21 and 11 to record a single marker on the control track where the directory is stored on the tape. During block S28, the microprocessor controller 31 causes the directory from RAM 33 onto the control track of the tape in close proximity to the marker. During block S29, the microprocessor controller causes logic 11 and control 5 to rewind slightly to a position before the directory. Thereafter during block S30, the microprocessor controller 31 causes control 5 to eject the cassette tape from the VCR.

Next, consider the operation of the system of Fig. 1 where the ejected tape of the previous example is reinserted into the VCR without disturbing the tape location in its cassette case, and the user starts to search for a particular program on the tape. The same method as in the previous example is used except that the VCR under control of microprocessor reads the directory off the tape at the position where the tape is inserted, and no searching of the tape for the directory is necessary.

The operation sequence enters block S9 (Fig. 2B) after tape cassette is loaded and awaits a function selection. The program enters block S10 when the user actuates the function SEARCH button 32b. During block S11, under control of the microprocessor controller 31, information is displayed on directory display 32e or video display 50 which prompts the user to input on keyboard 32a the name of the program or optionally, a program number on which to search. During block S12, the microprocessor controller 31 compares the value of the current tape location counter with the program location value LOC from the RAM for the program input by the user. If the program is located ahead on the tape, the microprocessor controller 31 causes logic 21 and control 5 to advance the tape to the desired location during block S13. Otherwise, if the program is already passed the current location, then the microprocessor causes the logic 21 and control 5 to rewind the tape to the desired location during block S14 following which the program is read and is played on screen 50a.

If address marks are stored in the VBI portion of the cassette tape, the search operation can be performed by obtaining the difference between the current address mark and the address mark of the target program. If the address marks are written onto the video frame as previously disclosed, the VCR control logic 21 can obtain their values through the VBI decoder 400 (see Fig. 12). The difference between the current address mark and the address mark of the target program is then set into the position logic and counter 9 (see. Fig 12). Depending on the sign of the substraction, either a fast forward or a fast rewind operation is then performed. When the tape counter reaches zero, the fast forward or the fast rewind operation is stopped and a PLAY operation is initiated to start playing the tape.

Next consider the operation of the system of Fig. 1 where either a blank tape cassette or a prerecorded tape cassette with no directory is inserted into the VCR. The directory controller is equipped to either play the tape as a regular tape or to allow the user to create a directory on the tape.

Refer to Figs. 2A and 2B. The cassette is loaded into the VCR during block S1. The microprocessor controller erases the directory 33a portion of RAM 33 to of any remnant directory from the last tape during block S2. During block S3, the microprocessor controller causes logic 21 control 5 and logic 11 to advance and read the tape to determine whether a

directory exists on the control track at the current tape location. If no directory exists on the tape at the point of insertion, the program enters block S3A during which time the tape is searched for a directory and if none are found, a blank directory is displayed and the sequence enters block S9 (Fig. 2D) where the microprocessor controller 31 awaits function selections.

When the user actuates the MODIFY button 37c, the program enters block S15 and then block S16. During block S16, the microprocessor controller 31 causes the user to be prompted on display 32e to enter a program name and/or program number, program location and program length (an entry) through keyboard 32a. Alternatively the prompt can appear on the display 50 and one of the titling methods described below can be used. During block S17, an entry is processed by the microprocessor controller 31 to form an entry for the directory, and the resultant entry is then stored into the directory 33a of RAM 33. The program then returns to block S9 to wait for further a function selection.

Consider the embodiment of Fig. 7 where the location of the latest or valid directory on the tape is stored on the magnetic strip 150 at the time of ejection. The location of the latest directory is read off the strip 150 by the magnetic write/sensor 154 into the RAM at reinsertion as a result of a change of magnetic flux caused by the horizontal or vertical movement of the tape cassette 40 with respect to the magnetic write/sensor 154. The use of the directory location information is only necessary if the tape has been moved in its cassette case such that when the tape is inserted, the directory cannot be immediately read off from the tape at the point of insertion. Fig. 10 depicts how the directory location information is used to facilitate searching for the valid directory, where the tape addresses include position indicator which indicate position along the tape from the BOT. During block S60, the tape cassette is inserted into the VCR. During block S62, any directory in the RAM 33 is cleared. During block S64, the encoded directory location information is read off by the magnetic write/sensor head 154 as the magnetic strip moves across the head. If the location read is not a valid location, then block S78 is entered to display a blank directory. Otherwise, the tape is rewound to BOT or to the first position indicator, if any, during block S68 to ascertain its absolute location. During block S70, the tape counter 9 is set to a value corresponding to the BOT or the value of the position indicator. The tape is then fast forwarded to the directory location during block S72 and the content of the directory is then read into RAM 33 during block S74 and displayed during block S76.

In the embodiment where the entire directory is stored on the magnetic strip 150 at the point of ejection and read off by the writer/sensor head 154 and into RAM 33 at the point of insertion, once the directory is in RAM 33, the tape is searched, played, recorded as

described in the previous examples. Fig. 11A depicts the flow diagram for loading a magnetic cassette with a magnetic strip affixed thereto and which holds the entire directory. During block S40 the cassette is physically inserted into the VCR. During block S42, the RAM 33 is cleared of any directory. During block S44, the horizontal or vertical motion (depending on a front loading or top loading VCR model) of the VCR cause a change of magnetic flux generated by the directory on the magnetic strip which is read by the magnetic write/sensor head 22. If no directory exists, then during block S45, the sequence jumps to block S52 to display a blank directory. Otherwise, block S46 is entered and the directory is stored into RAM 33. The tape is then rewound to BOT during block S48 and the tape counter is set to zero or the first position indicator in block S50 to correspond to the absolute position of the tape.

When the tape is ejected the entire directory in RAM 33 is written onto the magnetic strip 150 by the write/sensor head 154 as the cassette moves out of the VCR. Fig. 11B depicts the flow diagram for writing the entire directory to the magnetic strip during ejection of cassette when the EJECT button 3e is activated, block S200 is entered. During block S202 the RAM 33 is checked to determine whether a valid directory exist. If no directory exists, then block S206 is entered whereby the cassette is simply ejected. If a directory exists, then during block S204, the cassette is ejected and the directory is recorded on the magnetic strip 150 by the magnetic write/sensor head 154. The embodiments described above using the magnetic strip 150 may be implemented with the mechanical configurations described above in connection with Figs. 8 and 9, where the read/write head 154 is either stationary or is movable relative to the tape surface.

Preferably in each embodiment of this invention the directory is encoded to save space before it is written on the tape or magnetic strip and is then decoded after it is read from the tape or magnetic strip and stored in RAM.

Titles can be created and edited by a user before addition to the directory using the apparatus and methods described below and in Figs. 12-16. Referring to Fig. 12, the recorder of Fig. 1 is shown with several additional apparatus elements. A jog shuttle knob 3f, as is well-known in the art, can be used to rapidly advance the tape in the direction in which the knob is turned. Usually the knob has a center detent position which causes the display 50 to display a still frame of the video data on the tape directly over the read/write head. The jog shuttle knob is found on many professional-quality video cassette recorders, and is now available on some devices intended for the home market. An exemplary recorder with a jog shuttle knob is the Sony model SLV-373UC video cassette recorder, commercially available from Sony Corporation. Essentially, the jog shuttle knob replaces the traditional

fast forward and rewind controls on a VCR, and further enables slow-motion playback and rewinding, and still-frame viewing. As indicated, the jog shuttle knob is coupled to the VCR control logic 21 using means known in the art.

The VCR additionally comprises a character generator circuit 23 coupled to the control logic and to a character generator read-only memory (ROM) 25. Character generators are well-known in the art. Typically, the character generator ROM stores a data table representing pixel or bit patterns of a plurality of alphanumeric characters, such as the Roman alphabet and the Arabic numerals. Upon command by the control logic and the character generator circuit, the data in the character generator ROM is read and placed in an output signal to the video display at a position on the display determined by coordinates generated by the microprocessor. The end result is visual display of a alphanumeric character on the display screen. Character generators are well-known for channel display in television receivers, and for use in professional titling equipment.

The VCR also comprises a remote commander unit 1300 which communicates through wireless means with a remote signal receiver 29 in the VCR. As is known in the art, the remote commander comprises a plurality of push buttons, switches, and a jog shuttle knob which create output signals. The signals are transmitted by wireless means known in the art, such as infrared transmission or radio-frequency signals, to the remote signal receiver 29. The receiver decodes the received signal and passes the decoded data to the VCR control logic.

An exemplary remote control unit is the Remote Commander provided with the above-identified Sony VCR. Fig. 13 illustrates an embodiment of a remote control unit 1300. The unit comprises a hand-held housing 1322 provided with a plurality of push buttons 1301-1319. A remote jog shuttle knob 1320 is provided for hand-held operation of the jog shuttle feature of the VCR. A command mode selector switch 1301 enables activating the control unit. A plurality of channel number buttons 1302 enable remote entry of channel numbers. An ENTER button is used to enter channel numbers and menu options in the methods discussed below. A menu button 1304 is used to display a menu of user options, as discussed below. A plurality of cursor movement buttons 1305, each marked with an arrow, is used to move an on-screen cursor in various menu operations. An antenna TV/VTR button 1306 is used to command the video display 50 to display a signal coming either from an antenna or the output of the VCR. A power switch 1307 enables turning power to the VCR on and off.. A TV/VTR switch 1308 enables selectively using the remote control unit to control the VCR or the video display 50. An input select button 1309 enables selection of the source to be recorded. Channel change buttons 1310 enable toggling the channel

selection up and down. Similarly, volume buttons 1311 enable toggling the volume louder or softer. A record mode button 1312 enables selection of recording tape speed. A timer clear button 1313 is used to clear timer settings of the VCR. A timer record button 1314 is used to enter a timer recording mode. An index button 1315 is used to enter an index mode. Other buttons 1316-1319 can be used to control various functions on the VCR, including the direction, speed, and mode of the tape transport. The functions and implementation of each button are well known in the art, and have been commercially embodied in the above-mentioned Sony VCR.

Commercially available decoder circuits well known in the art for decoding the close caption broadcasting system for the deaf can be optionally connected to the directory controller 30 for automatic generation of the program title for the directory of the program being recorded. Television broadcasts include titles and subtitles transmitted during the VBI portion of the broadcast video signal, which can be decoded and displayed as text subtitles along with the video image by means of special decoding circuitry. Regular TV receivers do not decode nor process the signal, but with special decoder circuitry, the encoded text can be extracted and fed to the directory controller 30 for automatic generation of the title of the program being recorded. The extracted, decoded program title can be edited by a user or saved in the directory. Thus, the extracted program title can serve as an alternate data input source for the program directory, reducing the needed amount of user input.

As shown in Fig. 12, caption decoding can be implemented by coupling an input of a VBI signal decoder 400 to the output of a tuner 410 which is generally included in the majority of consumer VCR's for off-the-air recording. The tuner receives a broadcast TV signal from an antenna 420 or a cable TV signal source 421. Both the decoder, the tuner, and the interaction of both, are conventional in the art. Examples of commercially available VBI caption decoders include the TeleCaption 4000 Adaptor, commercially available from National Caption Institute, Falls Church, Virginia, and Teletext Decoder, available from Norpak Corporation, Ottawa, Canada. A decoder signal line 405 is coupled from the decoder to the VCR control logic 21 to carry decoded caption data to the control logic. The control logic is commanded by the microprocessor controller 31 to pass the decoded data to the directory 33a under control of a stored program in the RAM 33. The program then causes the caption information to be stored as a program title in the directory and displayed on the display 50. The caption data is sent to the directory during or immediately before step 1408, so that when the directory is displayed in step 1408, the caption data immediately appears in the directory display. A user then can edit the caption to adjust it as desired.

Caption data is placed in a broadcast TV signal by a broadcast TV station in a continuous stream; a user of the VCR 1 cannot stop or slow down the stream without additional hardware. Thus, it is possible that the first caption data received by the antenna 420 is not the program title. This problem can be overcome by coupling a data buffer memory 430 to the decoder. Under control of the decoder, all caption data received by the decoder is stored in the caption buffer and serially output to the control logic. Each caption data word is displayed in the directory, and the user presses the ENTER button to accept the word and store it as a program title. For a period of time dependent on the size of the buffer and the rate of data received by the decoder, received data remains in the buffer from which it can be recalled by a user and saved as a program title. When the buffer fills, any additional data words received will cause overflow, resulting in loss of the earliest received word. If a large enough buffer is used, this overflow effect will not be a problem. The functions of reviewing buffered data and storing saved titles can be controlled by a stored computer program or subroutine in the RAM.

Not only can the information (e.g. title, subtitle, program identification) transmitted during the VBI portion be displayed in real time or used to generate program title for the directory, it can be utilized to further facilitate operation of the VCR. For example, by monitoring the transmitted title, the VCR can automatically detect the end of a program and stop recording thereto. Also by monitoring the VBI portion used for transmitting the title, the VCR can filter out (in recording a program) segments that are unrelated to the program (e.g. commercials), by temporarily stopping the VCR if changes in the title portion are detected.

As described earlier, each video frame in the broadcast signal is divided into two fields, referred to as field 1 and field 2. In North America, each field consists of 262 1/2 lines, for a total of 525 horizontal lines per frame. The first 21 lines of each field comprise the vertical blanking interval or VBI. Conventionally, line 21 of field 1 has been used to transmit closed captioning information, which may be used as described above.

Alternately, line 21 of field 2 is being considered for broadcast of a variety of extended data services, including the broadcast of program identification information such as channel number, date, time, title and subject category of the program. This data may be broadcast at a relatively high repetition rate prior to broadcast, enabling a suitable decoder to detect the data. Thus, in the system of Fig. 12, the decoder 400 can be designed to receive and store in buffer 430 the program identification information from line 21 of field 2 of each frame. Using suitable logic, the program title and other information can be stored automatically in the directory 330, without user intervention.

Caption data decoding is further described in the following specifications, which are hereby incorporated by reference herein: Title 47, Code of Federal Regulations, Part 15 as amended by GEN. Docket No. 91-1; FCC 91-119; "CLOSED CAPTION DECODER REQUIREMENTS FOR THE TELEVISION RECEIVERS"; Title 47, CFR, Part 73.682(a)(22), Caption Transmission format; Title 47, CFR Part 73.699, figure 6; "TELEVISION SYNCHRONIZING WAVEFORM"; Title 47, CFR, Part 73.699, figure 17A; "LINE 21, FIELD 1 DATA SIGNAL FORMAT"; and PBS Engineering Report No. E-7709-C, "TELEVISION CAPTIONING FOR THE DEAF: SIGNAL AND DISPLAY SPECIFICATIONS".

The remote shuttle control, the character generator, and a control program stored in the directory controller can be used to create video titles for the program directory. In one embodiment, the methods of Figs. 14A, 14B are used in connection with an on-screen video display shown in Fig. 14C. The steps shown in Figs. 14A, 14B are invoked when the system enters steps S11 or S16 of Fig. 2B, step S78 of Fig. 10 or Fig. 11A, or steps S11, S16 of Fig. 11B. Upon entry of these steps, the system is placed under the control of a stored program coupled to the microprocessor containing instructions to implement the steps of Fig. 14A. Control is passed to step 1404 in which the system tests whether the directory display has been selected. If not, control is passed to step 1406 and the data-entry mode of Fig. 14A is terminated.

Otherwise, control passes to step 1408 in which the directory display 32e is shown on the video screen. The display may take the form of Fig. 14C, comprising a representation of an alphabetic keyboard 50b in the upper portion of the screen, and a video title 50g in the lower portion. The keyboard representation 50d resembles a standard QWERTY-style typewriter keyboard. A plurality of rows 50e are displayed, each including a plurality of single characters 50f. The characters 50f match the labels of the standard typewriter keys in a QWERTY-layout keyboard. Initially, the title 50g is entirely blank. If desired, the character spaces available for filling with a title can be represented by adjacent squares or rectangles as shown in Fig. 14C.

Control is passed to step 1410 in which the system waits until a key is pressed on the remote control unit 1300. If a cursor key 1305 if pressed, control is passed to step 1412 and the on-screen cursor is moved to a new location. Otherwise, the control is passed to step 1414 in which the system tests whether the enter button 1303 has been pressed. If so, control is passed to step 1416 and the cursor is moved to the character "Q" in the first row 50e of the keyboard representation 50d. Control is passed to step 1418 in which the system tests whether a cursor key 1305 has been pressed. If so, control is passed to step 1422 and the

cursor is moved to the next character in the keyboard representation 50d. If desired, the current character can be highlighted or shown in reverse video, as indicated by the character "C" at 50j. Otherwise, control is passed to step 1420 and the system tests whether the jog shuttle knob has been moved. If so, control is passed to step 1422 to move the cursor. Otherwise, control is passed to step 1424 and the system tests whether the enter key 1303 has been pressed. If so, the user is indicating that the current highlighted character 50j is desired to be entered in the current character 50k of the title 50g. Therefore, the control is passed to step 1426 in which the character 50j is copied to location 50k and "frozen" in place by displaying it in normal video. Control is then passed to step 1422, to advance the character position cursor 50k to the next position.

Otherwise, control is passed to step 1428 and the system tests whether the menu button 1304 has been pressed. If not, control is passed back to step 1418. If so, the user has indicated that the displayed title is complete and the user wishes to save the title in the directory. Therefore, control is passed to step 1430 in which the title shown at 50g is copied into one of the program title locations in the directory controller RAM 33. Control is passed to step 1406, thereby ending entry of a title.

Fig. 14B illustrates a method for advancing a keyboard representation cursor such as that shown at position 50j. Since the entire keyboard 50d is represented as a plurality of rows 50e, a command (using the cursor keys or jog shuttle knob) to advance the cursor requires special processing at the end of each row. For example, in step 1450 the system tests whether the left arrow cursor key has been pressed or the jog shuttle knob has been moved to the left. If so, the next task (step 1452) is to test whether the current character position is at the far left end of one of the rows 50e, i.e., whether the current character is Q, A, or Z. If so, control is passed to step 1454 in which the system handles the overflow condition by taking one of a plurality of possible steps. If desired, the system can simply do nothing, causing the cursor to freeze at the left end of the row. Alternatively, the cursor can jump to the far right end of the same row. For example, if the current character is "Q" and the user presses the left arrow cursor key, the cursor could jump to the letter "P" at the far end of the row. Further, the method could cause the cursor to jump to the end of the previous row, with "wrap around" if desired. Thus, if the cursor is on the letter "A" and the user presses the left arrow, the cursor can jump to the letter "P" on the row above. Any of these steps can be taken in step 1454. Otherwise, if the current cursor position is in the middle of a row, control is passed to set 1456 and the cursor is moved to the left.

A similar series of steps 1458, 1460, 1462, 1464 handles movement of the cursor to the right. In this case, overflow at step 1462 can result in freezing the cursor, moving it to the next row, etc.

As shown in steps 1466 to 1476, similar processing can be conducted for the "up" and "down" arrow cursor keys. Wrap around can be implemented. For example, when the "up" arrow button is pressed and the cursor is currently on the first row 50e, the cursor can be made to jump to the third row.

As is known in the art, the keyboard representation 50d can be created by commanding the character generator circuit 23 to output a particular character at a particular screen position. Thus, the microprocessor controller 31 can command the VCR control logic 21 to "write" a character on the screen by providing an ASCII code for a character and coordinates of the desired screen position. The control logic passes these parameters to the character generator with a command signal. The character generator receives the parameter data, retrieves a character bit map from the character ROM, and returns the appropriate display information to the control logic. The control logic inserts the character information into the output video signal and sends it to the video display. This step for commanding a character generator to output video characters to a display is known in the art.

Using the above steps, the jog shuttle remote can serve as a rapid data-entry unit to facilitate a quick selection of characters for a video program title.

An alternate method for creating video titles is shown in Figs. 15A and 15B. Steps 1502-1508 are the same as steps 1404-1412 of Fig. 14A. When step 1404 is reached, the display shown in Fig. 15B is placed on the video screen by the character generator unit.

As shown in Fig. 15B, a "scrollable" display 50c can comprise one or more title lines 50g, each comprising a plurality of characters 50h. During entry of a title, one of the characters 50h may be highlighted as designated by 50m. The highlighted characters referred to as the "cursor position" of the title.

When a new title is being entered, after the display of Fig. 15B is shown, control is passed to step 1510 of Fig. 15A. The cursor 50m is moved to the first (leftmost) position of the on-screen title. Control is next passed to step 1512 to display the current character at that location. Initially, the current character will be "A", which will appear in the leftmost position of the title. Control is passed to step 1514 in which the system tests whether an arrow button or the jog shuttle knob has been moved. If so, control is passed to step 1516. If the current character is "Z" or "A", special processing is required. If the current character is "Z", and the right button was pressed, then the cursor is change to "A". Likewise, if the current character is "A", and the left button is pressed, the current cursor changes to "Z".

These steps are effected in step 1518. Otherwise, control is passed to step 1520 in which the current character is incremented or decremented depending on whether the left or right buttons (or jog shuttle knob) have been pressed. Thereafter, control is passed to step 1512 to display the current cursor. In real time, the user sees the character at the current cursor position rapidly change from "A" through each letter of the alphabet as long as an arrow button or the jog shuttle knob is being operated.

If an arrow button or the jog shuttle knob is not in operation, control is passed to step 1522 and the system tests whether the "enter" button 1303 has been pressed. If so, the user desires to freeze and save the current character. Therefore, control is passed to step 1524 in which the current displayed character (and the remainder of the title) are saved in a memory location coupled to the microprocessor controller. The cursor is then advanced to the next available cursor position, if any, as indicated in step 1525. After the cursor is advanced, the current character at that position is displayed; as indicated above, this will be the letter "A".

If "enter" has not been pressed, control is passed to step 1526, in which the system tests whether the menu button 1304 has been pressed. If not, control is passed back to step 1512. If so, the user desires to save the entire title. Therefore, control is passed to step 1528 in which the entire displayed title is saved into one of the program title locations of the directory 33a in the RAM 33. Entry of a title is then complete and control terminates at step 1530.

Thus, using the method of Fig. 15A, rapid entry of video titles is possible. Each character position is handled seriatim, with the cursor passing from character to character until completion. At each character position, the display initially shows the letter "A", and then rapidly advances through the alphabet as the arrow buttons or jog shuttle knob are operated.

If no title is detected from the broadcast signals and if no title is entered by a user, then a default title is inserted into the directory. The default title may include such information as the channel from which the program is received, the date and time the program is recorded, etc.

Insertion of the cassette, as used herein, includes the manual insertion of the cassette into any mechanical tape carriage in the VCR as well as any movement by the VCR of the cassette on the carriage into a reading position adjacent heads 13, 15, 17 and 19.

The directory controller 30 is enhanced according to the present invention with additional features to facilitate management of records stored in a cassette of tape. These additional features are now described with reference to Figs. 18A and 18B.

The flow chart in Fig. 18B shows the additional options that are provided to a user when a directory is displayed in Fig. 18A.

When the user actuates the cursor movement keys step 1801 is entered. A pointer is provided in the microprocessor controller 31 to point to the directory 33a at the entry (or a field within an entry) identified by the cursor; when the cursor movement keys are actuated, this pointer moves correspondingly (step 1802).

If the ERASE button is then actuated (step 1803), the directory controller 30 will use the information from the directory 33a to locate the program and erase that program from the tape 42 (step 1804). After the program is erased, the directory 33a is updated (step 1805) to show that the entry is empty or available for recording a new program.

In addition to the normal erase operation described hereinabove, the directory controller 30 allows a user to "speed erase" a program. When this operation is initiated, by actuation (step 1806) of a predefined key pattern or sequence (such as a special "SPEED ERASE" key), the directory controller 30 simply invalidates the corresponding entry in the directory 33a without actually performing an erase operation on the tape 42 (step 1805).

The invalidation of step 1805 can be performed, for example, by setting an "invalidate" bit stored with the entry.

A recording operation can be performed in two different modes. According to the first mode, the cursor is moved to select an entry from the directory 33a. After the entry is selected, if a recording operation is initiated from the keyboard (step 1807), the directory controller 30 will record the program on the tape portion corresponding to the selected entry (step 1808). After the program is recorded on tape, the directory 33a is updated (step 1809).

The second mode of operation is initiated when the user actuates (step 1810) a predefined key pattern and sequence to perform a fast recording operation. In a fast recording operation, the director controller 30 operates to search for an empty entry which is long enough to record the program (step 1811). Algorithms may also be implemented so that an optimal entry, for example, one whose length is closest to the length of the program, is selected. When the entry is selected (step 1813), the directory controller 30 records the program thereon (step 1813), and the directory 33a is updated accordingly (step 1814).

The directory controller 33a also gives a user the option to view the title of the program being shown on the television. When this operation is initiated by actuating a predefined key pattern (step 1820), the directory controller 30 first investigates whether the VCR is showing a broadcasting program or a recorded program. If the VCR is showing a broadcasting program and if the title of the program is transmitted among the broadcast signals (as in the VBI portion as described above), the directory controller 30 will generate

the title from the broadcast signals and displays it on the television screen (step 1822). On the other hand, if the VCR is playing a recorded program, the directory controller 30 will retrieve the title from the directory 33a and display it on the screen (step 1823). In the preferred embodiment, a timer is kept in the directory controller 30 so that the title is removed from the screen after five seconds (step 1824).

The user is also provided with an option to create a library in a memory such the system data area 33B to store the directories of selected tapes. When a tape is inserted into the VCR, the user can initiate an "Add Library" operation (step 1832) by actuating a predefined key pattern or sequence. Responsive to the "Add Library" operation, the directory controller adds the directory of the tape to the library (step 1834).

The user can also perform a "library" operation (step 1830). Under this operation, the list of tapes stored in the library is displayed (step 1831). Optionally, the title of the first program in each directory is displayed along with the title of the tape.

Figs. 24A-24G are flow charts illustrating the user interface and operation of a controller in which the present invention is embodied.

With reference to Fig 24A, the controller in step 2401 checks whether a cassette tape has been inserted. If no cassette tape is inserted and the controller's buttons are actuated, then block 2402 is entered.

In step 2404, a determination is made to see whether the cassette tape is enhanced with the present invention. If the cassette tape is one which is not enhanced with the present invention, then a first type of menu, like the one shown in 2406 is displayed. On the other hand, if the cassette tape is one which is enhanced in accordance with the present invention, then a second type of menu, like the one shown in 2408 with additional options, is displayed.

Fig. 24B also shows how operation of the VCR is facilitated by the present invention. For example, in a rewind or a fast forward operation, the program counter and tape position cursor can be displayed; and in an erase operation, the program can be "erased" by simply deleting it from the directory.

Fig. 24B also illustrates that the user is provided with an option to display the program title (program ID) on the screen, both when the television is showing a VCR program and when it is showing a broadcasting program.

Figs. 24C-24E show how an enhanced record operation can be enhanced by the present invention. For example, from step 2431, the directory is searched to find a location on which a program can be recorded in a timer recording operation, or the user can select a location himself. From step 2441, the controller operate to insert a title onto the directory.

The foregoing description should not be read as pertaining only to the precise structures and techniques described, but rather should be read consistent with, and as support for, the following claims, which are to have their fullest and fair scope.

WHAT IS CLAIMED IS:

1. A method, using a tape machine, for maintaining on a tape in a cassette a directory comprising a representation of each of a plurality of records recorded on the tape and a representation of the position along the tape where each said record is recorded wherein the cassette with the tape may be repeatedly inserted into, read by and then removed from the tape machine and wherein the tape machine moves the tape within the cassette during reading and recording on the tape, the method comprising of steps of:

creating entries in said directory, the step of creating entries comprising the step of creating in each said entry a representation of a different one of the records for the tape and a representation of the position along the tape for such record; and

recording the directory, with at least one of the entries therein, on the tape, prior to each removal of the cassette from the tape machine, adjacent the position on the tape at which the tape machine will commence reading of the tape when the cassette is reinserted in the tape machine.

2. The method of claim 1, wherein the step of recording comprises the step of recording on the tape a current position of the tape at which the tape machine will commence reading the tape upon reinsertion of the cassette in the tape machine.

3. The method of claim 2, comprising the step of storing the directory read from the tape in a memory for retention.

4. The method of claim 1, comprising the step of creating markers on the tape to uniquely identify a current directory.

5. The method of claim 2, comprising the step of erasing the directory from the tape immediately after the step of reading the directory.

6. The method of claim 2, further comprising the step of causing the tape machine to reposition the tape in the cassette, after reading the directory and prior to removal of the cassette, to a position such that the directory will be read out by the tape machine upon reinsertion of the cassette in the tape machine and before reading by the tape machine of one of the records from the tape.

7. The method of claim 2 comprising the additional step of updating the current position in the memory as the tape is being moved for reading.

8. The method of claim 7, wherein the step of recording the directory on the tape comprises the step of recording an updated position of the tape in the cassette on the tape.

9. The method of claim 1, wherein the records on the tape comprise video programs and comprising the step of reading the programs with the tape machine and forming a video display of the programs read by the tape machine from the tape.

10. The method of claim 1, wherein the tape machine further comprises a sensor for reading a current position from a storage medium on a side of the cassette, and wherein the tape machine ascertains the position of a current directory, comprising the additional steps of:

reading a current position from the storage medium on the side of the cassette during insertion of the cassette into the tape machine; and

writing a current position of the tape on the storage medium during removal of the cassette from the tape machine.

11. The method of claim 10, comprising the step of forming a visible display of both the stored directory and the stored current position.

12. The method of claim 4, wherein the method of forming a marker comprises the steps of:

recording a first marker on the tape in close proximity to a current directory when said directory is recorded on the tape;

searching along the tape for a current directory with said first marker; and

recording a second marker on the tape in close proximity to the first marker when the current directory is read.

13. The method of claim 4, wherein method of forming a marker comprises the steps of:

recording a marker on the tape in close proximity to a current directory when said directory is recorded on the tape;

searching along the tape for a current directory with said marker in close proximity thereto; and

erasing said first marker when the current directory is read.

14. The method of claim 1, further comprising the step of entering a program title for one of the records of the directory.

15. The method of claim 15, wherein the entering step comprises the steps of:

(a) displaying a title entry field on a video display coupled to the tape machine, the field including a plurality of characters and a cursor movable thereon;

(b) receiving input from a first user input device coupled to the tape machine, and in response thereto, changing the position of the cursor to identify characters in the title; and

(c) receiving input from a second user input device coupled to the tape machine, and in response thereto, transferring the title to a record of the directory; and

16. The method of claim 15, wherein the first user input device is a jog shuttle knob of a remote control unit coupled to the tape machine.

17. The method of claim 15, wherein the second user input device is an entry button of a remote control unit coupled to the tape machine.

18. The method of claim 14, wherein the step of entering a program title further includes the step of displaying a keyboard representation proximate the title entry field on the display.

19. The method of claim 15, wherein in response to movement of the first user input device, the cursor moves sequentially among characters of the keyboard.

20. The method of claim 15, wherein the cursor comprises a scrollable character displayed at a discrete movable position in the title entry field.

21. The method of claim 18, wherein the keyboard representation comprises a plurality of rows of the characters, and comprising the step of moving the cursor to the first character of a previous row when the cursor reaches the end of a current row.

22. The method of claim 1, further comprising the step of entering a program title for a record of the directory by decoding a program title contained in the VBI using the decoding means and storing the program title in the directory in the storage means.

23. The method of claim 22, wherein said program title is recorded in line 21 of field 2 of the VBI.

24. A directory controller for a tape machine, for maintaining on a tape in a cassette a directory comprising a representation of each of a plurality of records recorded on the tape and a representation of the position along the tape where each said record is recorded wherein the cassette with the tape may be repeatedly inserted into, read by and then removed from the tape machine and wherein the tape machine moves the tape within the cassette during reading and recording on the tape, the directory controller comprising:

means for creating entries in said directory, comprising means for creating in each said entry a representation of a different one of the records for the tape and a representation of the position along the tape for such record; and

means for enabling recording of the stored directory, with at least one of the entries therein, on the tape, prior to each removal of the cassette from the tape machine, adjacent the position on the tape at which the tape machine will commence reading of the tape when the cassette is reinserted in the tape machine.

25. The controller of claim 24, wherein the controller comprises means for creating markers on the tape to uniquely identify a current directory.

26. The controller of claim 24, comprising means for erasing the directory from the tape immediately after the directory is read.

27. The controller of claim 24, comprising means for causing the tape machine to reposition the tape in the cassette, after the directory is read and prior to removal of the cassette, to a position such that the directory will be read out by the tape machine upon reinsertion of the cassette in the tape machine and before reading by the tape machine of one of the records from the tape.

28. The controller of claim 24, comprising means for causing the tape machine to record on the tape with the recorded in association with the directory, a current position of the tape at which the tape machine will commence reading the tape upon reinsertion of the cassette in the tape machine.

29. The controller of claim 28, wherein the microprocessor controller comprises means for enabling the stored current position in the memory to be updated as the tape is moved for reading.

30. The controller of claim 29, wherein the microprocessor controller comprises means for enabling recording of the updated position on the tape with the directory.

31. The directory controller of claim 24, comprising a battery for maintaining power to the memory.

32. The controller of claim 24, wherein said means for creating entries comprises:

a microprocessor controller for enabling the tape machine to read the directory from the cassette when the tape machine begins the reading of the tape after the cassette has been inserted for reading in the tape machine;

a memory for storing the directory read from the cassette;

a character generator, coupled to a character generator memory device, in the tape machine;

a remote control unit, with cursor positioning means therein, and a remote signal receiver in the tape machine for receiving cursor position signals from the remote control unit by wireless means; and

said microprocessor controller comprising means for enabling entry of an on-screen program title and recording of the stored directory on the cassette, prior to removal of the cassette from the tape machine, adjacent the position on the tape at which the tape machine will commence reading of the tape when the cassette is reinserted in the tape machine.

33. The controller of claim 32, comprising means for forming entries in said directory in the memory, the means for forming entries comprising means for forming in each said entry a representation of a different record on the tape and a representation of the relative position along the tape where such each record is recorded, comprising: stored program control

means coupled to the microprocessor controller for: (a) displaying a keyboard representation on a video display coupled to the tape machine, the keyboard representation including a plurality of characters and a cursor generated by the character generator; (b) receiving input from a first user input device coupled to the tape machine, and in response thereto, changing the position of the cursor; and (c) receiving input from a second user input device coupled to the tape machine, and in response thereto, transferring the title to a record of the directory.

34. The controller of claim 33, wherein the first user input device is a jog shuttle knob of a remote control unit for the tape machine.

35. The controller of claim 33, wherein the second user input device is an entry button of the remote control unit.

36. The controller of claim 32, comprising means using the character generator for forming a visible display of both the stored directory and the stored current position.

37. The controller of claim 24, wherein the tape machine further comprises a sensor for reading a current position from a side of the cassette, and means for ascertaining the position of a current directory, comprising:

means for reading a current position from the side of the cassette during insertion of the cassette into the tape machine; and

means for writing a current position of the tape on the side of the cassette during removal of the cassette from the tape machine.

38. The controller of claim 37, further comprising the step of recording the stored directory onto the side of the cassette during removal of the cassette from the tape machine.

39. The controller of claim 33 comprising the step of rewinding the tape in the cassette until the position of the tape relative to a beginning of the tape can be ascertained and then rewinding the tape in the cassette from the ascertained tape position until the position of a desired program indicated in the directory has been reached.

40. The controller of claim 24 further comprising:

stored program control means coupled to the microprocessor controller for entering a program title for one of the records of the directory by decoding a program title contained in the VBI using the decoding means and storing the program title in the directory; and

recording the stored directory on the cassette, prior to each removal of the cassette from the tape machine.

41. The directory controller of claim 40, wherein the means for entering a program title further comprises:

means for displaying a title entry field on a video display coupled to the tape machine, the field including a plurality of characters and a cursor movable thereon; and

means for receiving input from a jog shuttle knob coupled to the tape machine, and in response thereto, changing the position of the cursor to modify characters in the title.

42. The directory controller of claim 40, wherein the means for entering a program title further comprises means for receiving input from an entry button of the remote control unit, and in response thereto, for transferring the title to a record of the directory.

43. The directory controller of claim 40, wherein the means for entering a program title further comprises means for displaying a keyboard representation proximate the title entry field on the display.

44. The directory controller of claim 41, wherein the means for entering a program title comprises means for moving the cursor sequentially among characters of the keyboard in response to movement of the jog shuttle knob.

45. The directory controller of claim 40, wherein the decoding means comprises means for decoding data broadcast in line 21 of field 2 of the VBI.

46. A method, using a tape machine, a sensor and a memory, for maintaining and making available on the side of a magnetic tape cassette a directory comprising a representation of each of a plurality of records recorded on the tape and a representation of the position along the tape where each said record is recorded, wherein the cassette with the tape may be repeatedly inserted into, read by and then removed from the tape machine and wherein the tape machine moves the tape within the cassette during reading and recording on the tape, the method comprising of steps of:

reading the directory from the side of the cassette with the sensor during insertion of the cassette into the tape machine;

storing the directory in the memory for retention while the tape machine starts reading the tape;

entering a program title for one of the records by

(a) displaying a keyboard representation, using the character generator, on a video display coupled to the tape machine, the keyboard representation including a plurality of characters and a cursor;

(b) receiving input from a jog shuttle knob of a remote control unit for the tape machine, and in response thereto, changing the position of the cursor;

(c) receiving input from an entry button of the remote control unit, and in response thereto, transferring the title to a record of the directory; and

recording the stored directory onto the side of the cassette during removal of the cassette from the tape machine.

47. The method of claim 46, comprising the step of rewinding the tape in the cassette until the position of the tape relative to a beginning of the tape can be ascertained and then rewinding the tape in the cassette from the ascertained tape position until the position of a desired program indicated in the directory has been reached.

48. The method of claim 46, comprising the step of modifying the content of the directory in the memory to reflect modification of the records recorded on the tape.

49. The method of claim 46, wherein the step of receiving comprises the step of receiving the program title from the vertical blanking interval of the broadcast television signal.

50. The method of claim 46, wherein the step of receiving comprises the step of receiving the program title from line 21 of field 2 of the vertical blanking interval.

51. A directory controller for a tape machine and a memory, for maintaining and making available on a side of a magnetic tape cassette a directory comprising a representation of each of a plurality of records recorded on the tape and a representation of the position along the tape where each said record is recorded wherein the cassette and tape may be repeatedly inserted into, read by and then removed from the tape machine and wherein the tape machine moves the tape within the cassette during reading and recording on the tape, the directory controller comprising:

a sensor for reading the directory from the side of the cassette during insertion of the cassette into the tape machine;

a memory for storing the directory read from the cassette when the tape machine starts reading said tape;

character generation means in the tape machine coupled to microprocessor controller for generating video characters on a video display coupled to the tape machine;

stored program control means coupled to the microprocessor controller for

(a) displaying a keyboard representation on a video display coupled to the tape machine, the keyboard representation including a plurality of characters and a cursor generated by the character generator;

(b) receiving input from a jog shuttle knob of a remote control unit for the tape machine, and in response thereto, changing the position of the cursor;

(c) receiving input from an entry button of the remote control unit, and in response thereto, transferring the title to a record of the directory; and

means for enabling recording of the stored directory onto the side of the cassette during removal of the cassette from the tape machine.

52. The directory controller of claim 51, comprising means for enabling rewinding of the tape in the cassette until the position of the tape relative to a beginning of the tape can be ascertained and means then for enabling winding the tape in the cassette from the ascertained tape position until the position of a desired program indicated in the directory has been reached.

53. The directory controller of claim 51, comprising means for modifying the content of the directory in the memory to reflect modification of the records recorded on the tape.

54. In a magnetic tape cassette machine, a method for automatically maintaining a program directory to be carried on the exterior of a magnetic tape cassette inserted in the tape machine, where the program directory provides a list of a series of programs recorded on magnetic tape in the corresponding cassette, the method comprising the steps of

receiving a program title from broadcast television signal of a program where the program is for recording on a magnetic tape of the inserted cassette; and

updating the directory carried on the exterior of the inserted cassette with the received program title when such cassette is ejected from the cassette tape machine.

55. A directory controller for automatically updating a program directory to be carried on the exterior of a magnetic tape cassette, where the program directory provides a list of a series of programs recorded on magnetic tape in the corresponding cassette, comprising:

a magnetic tape cassette machine;

means for receiving a program title from broadcast television signal of a program for recording on a magnetic tape of the inserted cassette; and

means for updating the directory carried on the exterior of the inserted cassette with the received program title whenever such cassette is ejected from the tape machine.

56. The directory controller of claim 55, wherein the means for receiving comprises means for receiving the program title from the vertical blanking interval of the broadcast television signal.

57. The directory controller of claim 55, wherein the means for receiving comprises means for receiving the program title from line 21 of field 2 of the vertical blanking interval of the broadcast television signal.

58. A magnetic tape machine comprising:

a first magnetic head unit for retrieving video signals from a cassette of magnetic tape,

a second magnetic head unit for retrieving data from a magnetic strip, including directory information on programs of video signals stored in the cassette of magnetic tape, and

means for communicating the directory information to a controller for displaying thereby, in facilitating operation of the magnetic tape machine.

59. A magnetic tape machine as in claim 58, wherein said second magnetic head unit is positioned to read the magnetic strip which is placed on top of the cassette.

60. A magnetic tape machine as in claim 58, wherein said second magnetic head unit is positioned to read the magnetic strip at a back side opposite to the front side of the cassette where the magnetic tape is read.

61. A magnetic tape machine as in claim 58, wherein the second magnetic head unit is stationary.

62. A magnetic tape machine as in claim 61, wherein the second magnetic head unit has a magnetic tape sensor for sensing a control track and a second magnetic tape sensor for sensing a data track.

63. A magnetic tape machine as in claim 58, including means for creating a representation on the directory that a program stored on the tape is erased.

64. A magnetic tape machine as in claim 58, including means for searching the directory for a location in the tape that is available for storing a new program.

65. A magnetic tape machine as in claim 58, wherein the controller comprises means for inserting a title for a program stored on the tape.

66. A magnetic tape machine as in claim 65, wherein the title inserting means comprises means for inserting a default title having a field specifying the time the program is recorded.

67. A magnetic tape machine as in claim 58, wherein the second magnetic head unit moves in retrieving information.

68. A magnetic tape machine as in claim 67, further comprising a motor coupled to said second magnetic head unit.

69. A magnetic tape machine as in claim 58, further comprising means for recognizing an identification mark on said magnetic strip.

70. A magnetic tape machine as in claim 69, wherein said recognizing means comprises a light emitting diode.

71. A magnetic tape machine as in claim 69, wherein said recognizing means comprises a laser.

72. A memory for attaching to a cassette of magnetic tape to provide storage of a directory on data recorded on the tape, comprising:

a supporting base;

a magnetizable medium on the base; and

means on the base for attaching the memory to the cassette.

73. A memory as in claim 72, wherein the base in a card.

74. A memory as in claim 72, wherein the magnetizable medium is a magnetic strip.

75. A memory as in claim 74, wherein the card has a guide for guiding a magnetic sensor in sensing the magnetic strip.

76. A memory as in claim 75, wherein the guide is a groove parallel to the strip.

77. A memory as in claim 76, wherein at least one end of the groove has a depression wider than the groove to facilitate engagement of the magnetic sensor to the groove.

78. A memory as in claim 74, further comprising a resilient material supporting the tape on the card.

79. A memory as in claim 72, further comprising an identification mark of light reflective material.

80. A video cassette tape machine, comprising:

first recording means for recording video signals on a cassette of magnetic tape,

first sensing means for sensing video signals from a cassette of magnetic tape,

means for transmitting the video signals sensed from the first sensing means to a television to generate pictures thereon,

means for providing a directory on programs of video signals stored on a magnetic tape,

means for displaying said directory,

means for receiving a command for a user,

means responsive to a command and information from said directory for facilitating operation of the video cassette tape machine.

81. A video cassette tape machine as in claim 80, wherein said facilitating means comprises means for writing a representation on the directory to indicate that the program is erased.

82. A video cassette tape machine as in claim 80, wherein said facilitating means comprises means for searching the directory for a location on the tape to store a program.

83. A video cassette tape machine as in claim 78, wherein said facilitating means comprises means for displaying a title of the video signals that are generating pictures on the television.

84. A video cassette tape machine as in claim 83, further having means for retrieving, from the directory, a title corresponding to a program being sensed by the first sensing means, and wherein the title displaying means displays the retrieved title.

85. A video cassette tape machine as in claim 83, further comprising means for receiving broadcasting television signals, and wherein the controller further having means for decoding

from the broadcasting television signals a title, and wherein the title displaying means display the decoded title.

86. A video cassette tape machine as in claim 80, further comprising means for providing a library storing the directories of a plurality of cassettes.

87. A video cassette tape machine as in claim 86, further comprising means for displaying titles of cassettes whose directories are stored in the library.

88. A video cassette tape machine as in claim 87, wherein the library displaying means further displays the title of at least one program of each directory stored in the library.

89. A video cassette tape machine as in claim 86, further comprising means for adding a directory to the library.

90. A video cassette tape machine as in claim 80, wherein the controlling means further comprises means for inserting address marks on a tape.

91. A video cassette tape machine as in claim 90, further comprising means for identifying vertical blanking intervals in broadcasted television signals, and wherein the means for inserting address marks includes means for inserting the address marks onto the vertical blanking intervals.

92. A video cassette tape machine as in claim 91, further comprising a tape counter, and wherein said means for inserting address marks includes means for inserting output from the tape counter onto the vertical blanking intervals.

93. A video cassette tape machine as in claim 80, further comprising means for receiving signals being broadcasted and means for identifying among said broadcasted signals a program title, and means responsive to said program title for controlling said first recording means.

94. A video cassette tape machine as in claim 93, wherein said controlling means comprises means for halting recording of a program when a change of program title is identified.

95. A video cassette tape machine as in claim 80, further comprising a second recording means for recording the directory into a memory separate from the tape and a second sensing means for reading the directory from the memory.

96. A video cassette tape machine as in claim 95, wherein the second sensing means is a magnetic sensor for sensing data from a magnetic strip.

97. A video cassette tape machine as in claim 96, wherein the second sensing means is a circuit for reading data from a semiconductor memory.

98. A method for facilitating operation of a video cassette tape machine which operates to sense video signals from a cassette of magnetic tape and transmit the video signals to a television to generate pictures, the method comprising the steps of:

providing a directory having entries of information relating to programs, including respective titles thereof, stored on the tape,

storing the directory in a memory on the cassette so that the directory can be retrieved when the tape is being read by the tape machine,

displaying said directory on a display,

allowing a user to individually identify an entry on the directory and enter a command regarding an identified entry, and

performing said command using information from said directory.

99. A method as in claim 98, further comprising the step of making, in response to a command of erasing a program from the tape, a representation in the directory that the program is erased.

100. A method as in claim 98, further comprising the step of searching, in response to a command of recording a program to the tape, the directory for a location in the tape for storing the program.

101. A method as in claim 98, further comprising the step of retrieving, in response to a command of display a title of program being played on a television, the title from the directory and displaying the retrieved title.

102. A method as in claim 98, further comprising the step of inserting a tape counter value onto the tape as address marker.

103. The method as in claim 102, wherein the inserting step inserts the counter value during a Vertical Blanking Interval.

104. The method as in claim 98, further comprising the step of storing the directory of a tape into a library.

105. The method as in claim 104, wherein the library is stored in a memory with the video cassette tape machine.

106. A magnetic tape cassette having:

a casing,

a magnetic tape, within the casing, and

a memory.

107. A magnetic tape cassette as in claim 106, wherein the memory is a magnetic strip.

108. A magnetic tape cassette as in claim 107, wherein the casing has a parallelpiped structure.

109. A magnetic tape cassette as in claim 108, wherein the casing has a depressed area for receiving the magnetic strip.

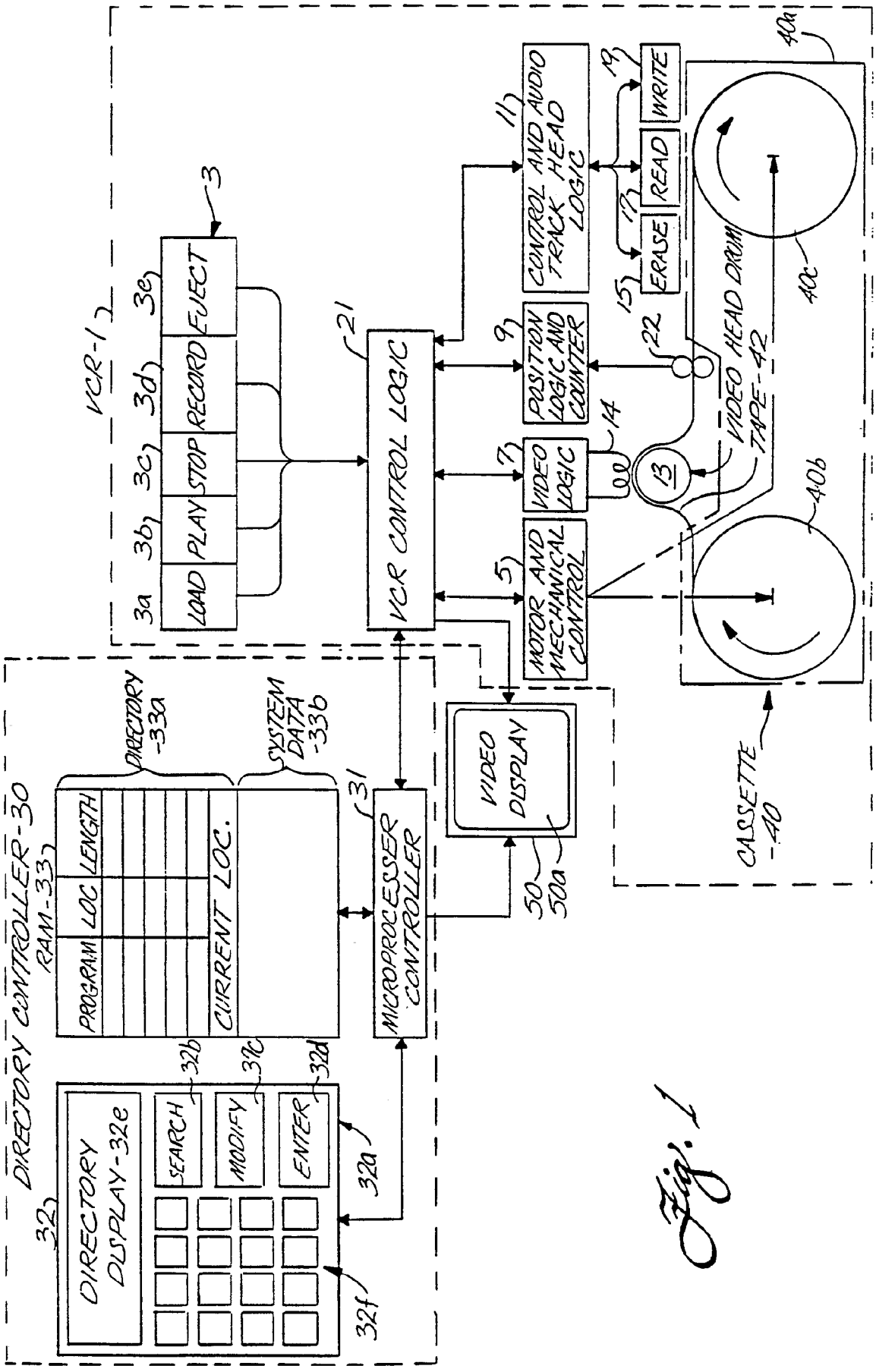
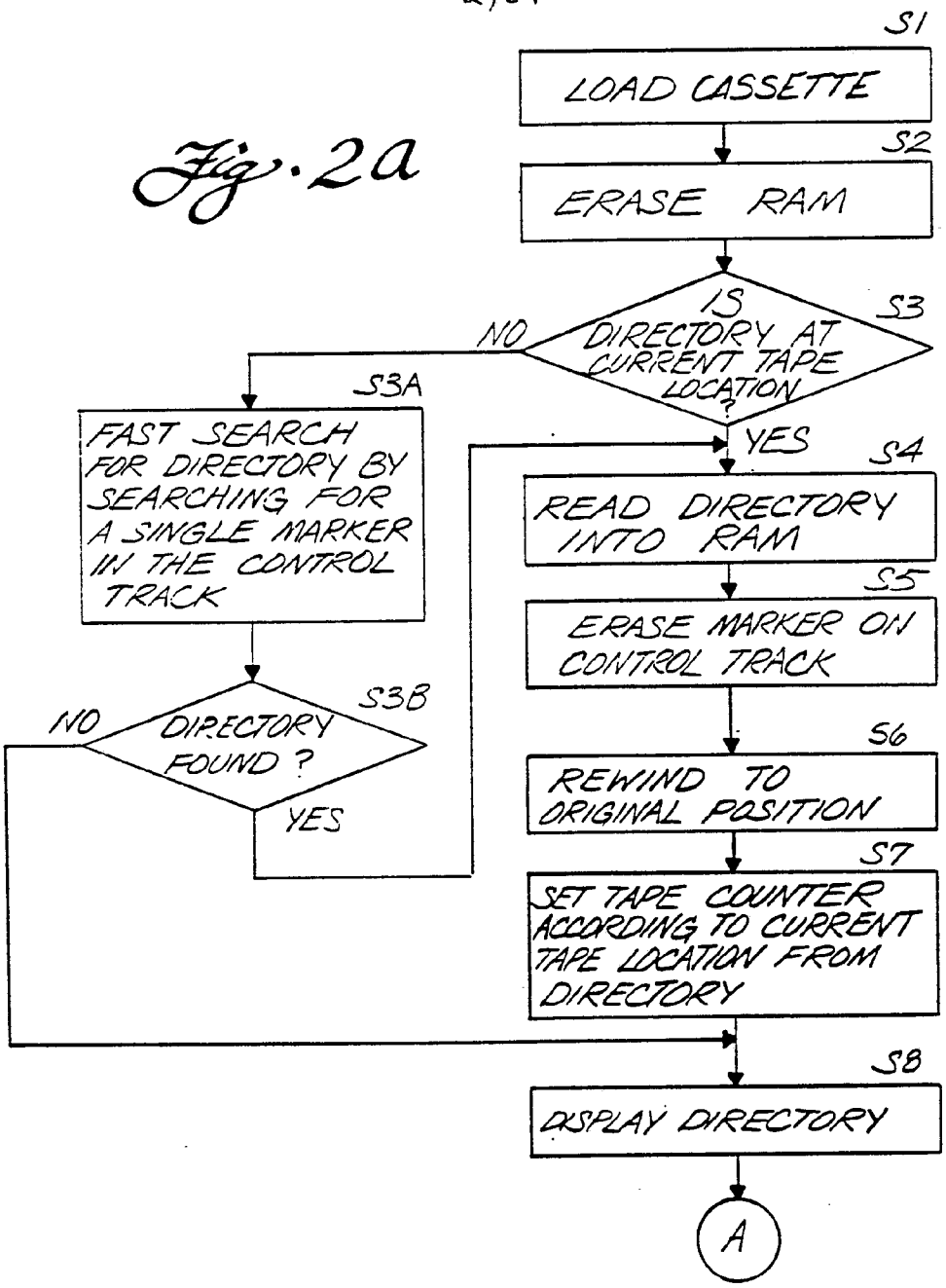

VCR-1
3
3a LOAD
3b PLAY
3c STOP
3d RECORD
3e EJECT
21
VCR CONTROL LOGIC
11
CONTROL AND AUDIO TRACK HEAD LOGIC
19
WRITE
17
READ
15
ERASE
9
POSITION LOGIC AND COUNTER
22
7
VIDEO LOGIC
14
13
VIDEO HEAD DRUM
TAPE-42
5
MOTOR AND MECHANICAL CONTROL
40a
40c
40b
CASSETTE -40
DIRECTORY CONTROLLER-30
RAM-33
PROGRAM
LOC
LENGTH
CURRENT LOC.
DIRECTORY -33a
SYSTEM DATA -33b
31
MICROPROCESSER CONTROLLER
VIDEO DISPLAY
50
50a
32
DIRECTORY DISPLAY-32e
SEARCH
MODIFY
ENTER
32a
32b
32c
32d
32f

Fig. 1

Fig. 2a


S1
LOAD CASSETTE
S2
ERASE RAM
S3
IS DIRECTORY AT CURRENT TAPE LOCATION ?
NO
YES
S3A
FAST SEARCH FOR DIRECTORY BY SEARCHING FOR A SINGLE MARKER IN THE CONTROL TRACK
S3B
DIRECTORY FOUND ?
NO
YES
S4
READ DIRECTORY INTO RAM
S5
ERASE MARKER ON CONTROL TRACK
S6
REWIND TO ORIGINAL POSITION
S7
SET TAPE COUNTER ACCORDING TO CURRENT TAPE LOCATION FROM DIRECTORY
S8
DISPLAY DIRECTORY
A

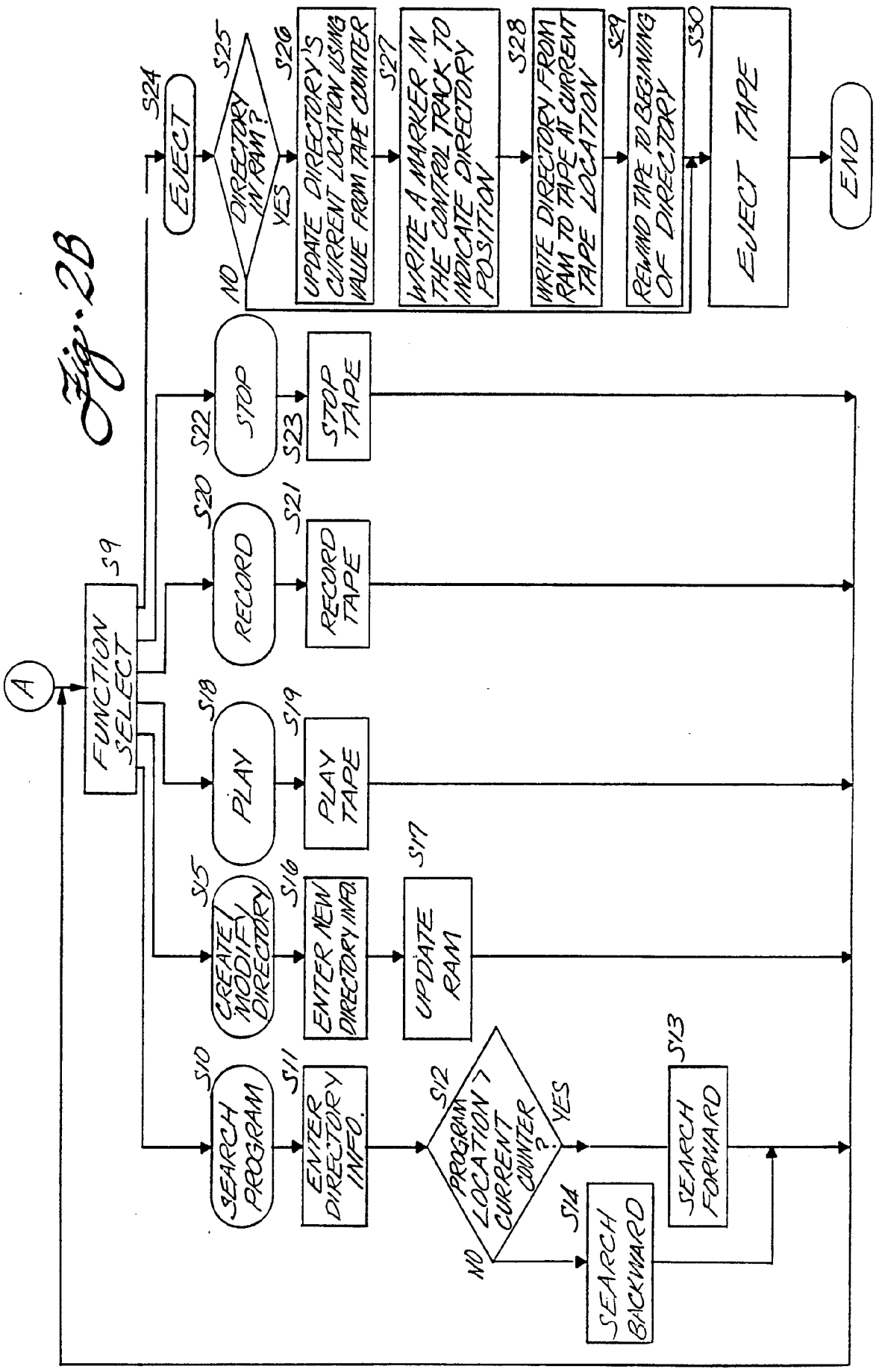

A
FUNCTION SELECT
S9
SEARCH PROGRAM
S10
ENTER DIRECTORY INFO.
S11
PROGRAM LOCATION = CURRENT COUNTER ?
S12
YES
NO
SEARCH BACKWARD
S14
SEARCH FORWARD
S13
CREATE/ MODIFY DIRECTORY
S15
ENTER NEW DIRECTORY INFO.
S16
UPDATE RAM
S17
PLAY
S18
PLAY TAPE
S19
RECORD
S20
RECORD TAPE
S21
STOP
S22
STOP TAPE
S23
EJECT
S24
DIRECTORY IN RAM ?
S25
YES
NO
UPDATE DIRECTORY'S CURRENT LOCATION USING VALUE FROM TAPE COUNTER
S26
WRITE A MARKER IN THE CONTROL TRACK TO INDICATE DIRECTORY POSITION
S27
WRITE DIRECTORY FROM RAM TO TAPE AT CURRENT TAPE LOCATION
S28
REWIND TAPE TO BEGINNING OF DIRECTORY
S29
EJECT TAPE
S30
END

Fig. 2B

Fig. 3

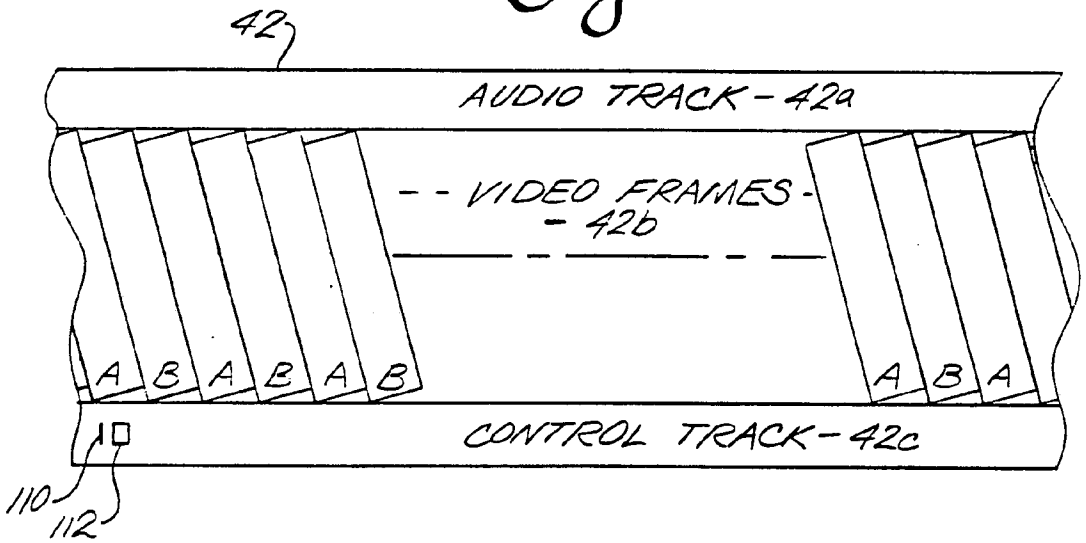

42
AUDIO TRACK - 42a
- - VIDEO FRAMES - - 42b
A B A B A B
A B A
CONTROL TRACK - 42c
110
112

Fig. 4

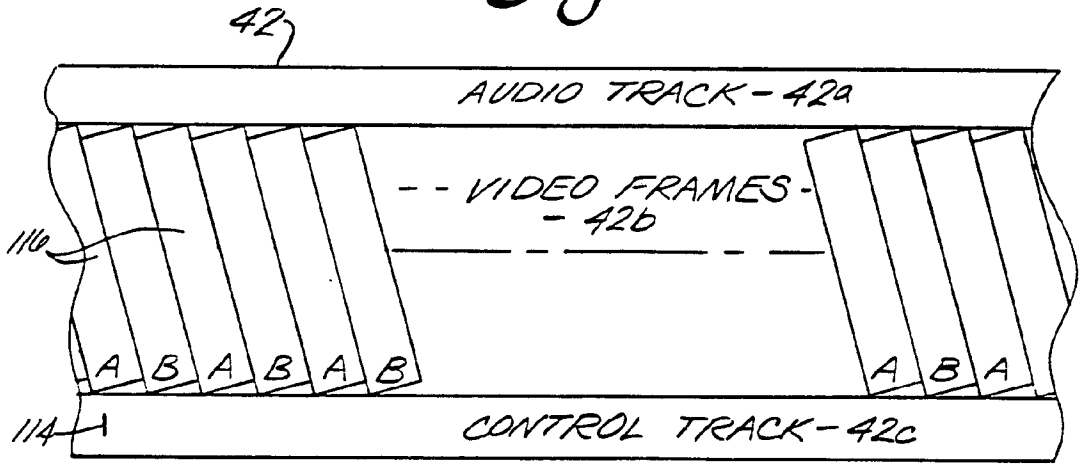

42
AUDIO TRACK - 42a
- - VIDEO FRAMES - - 42b
116
A B A B A B
A B A
114
CONTROL TRACK - 42c

Fig. 5a

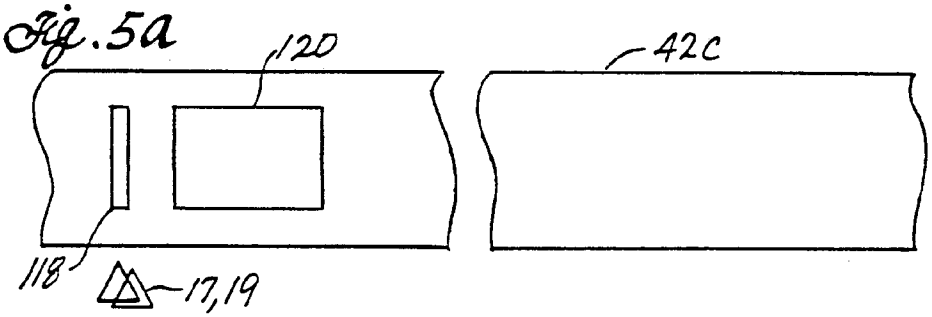


Fig. 5B

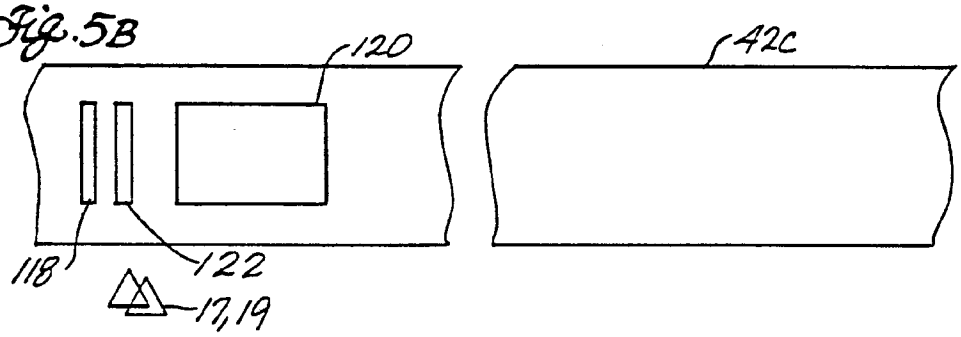


Fig. 5c

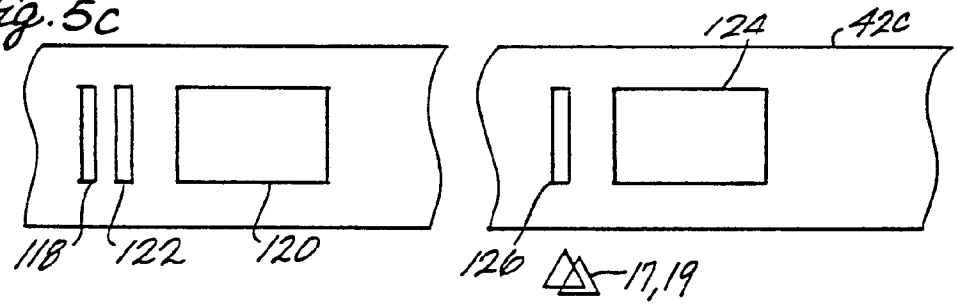


Fig. 5D

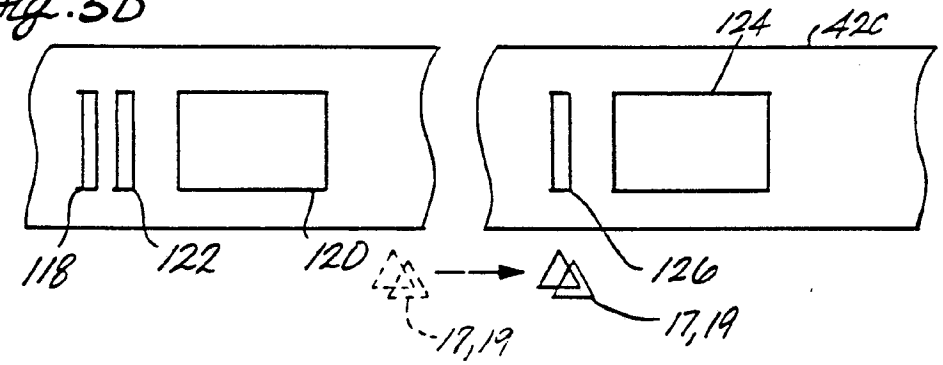


Fig. 6a

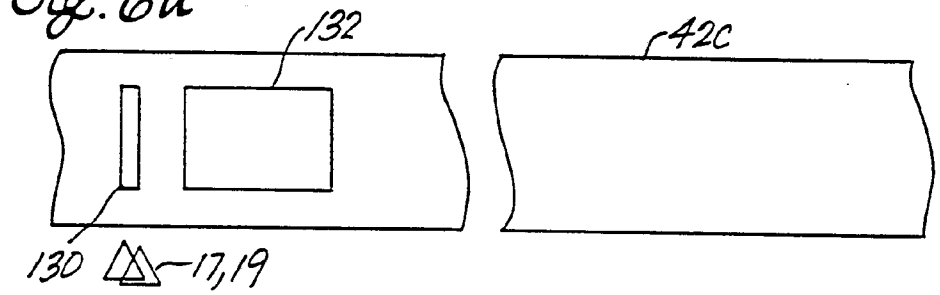


Fig. 6B

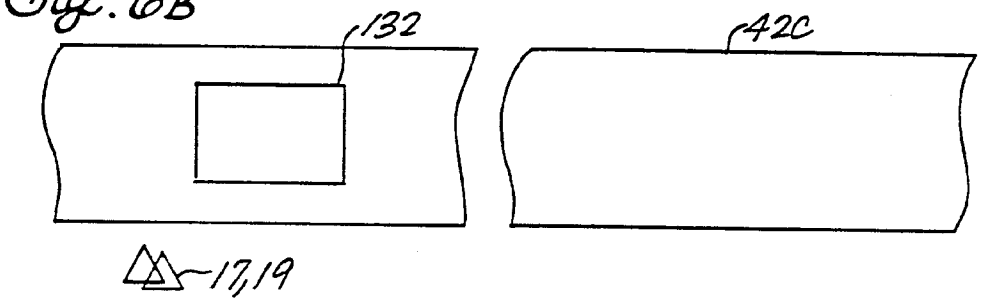


Fig. 6C

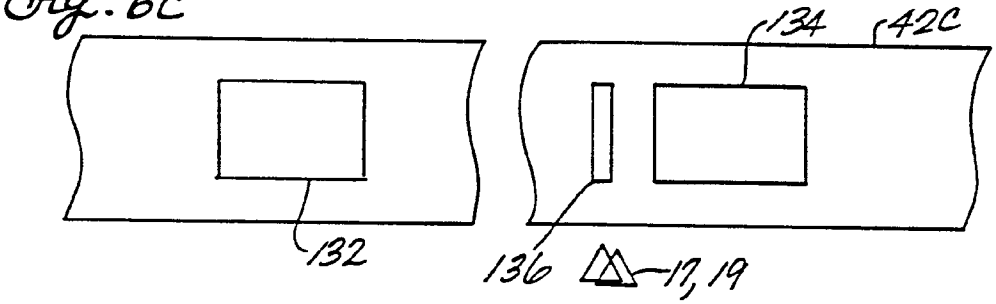
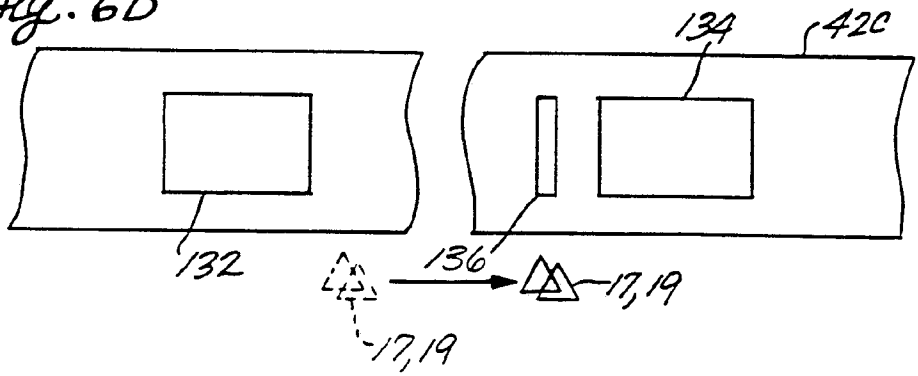


Fig. 6D



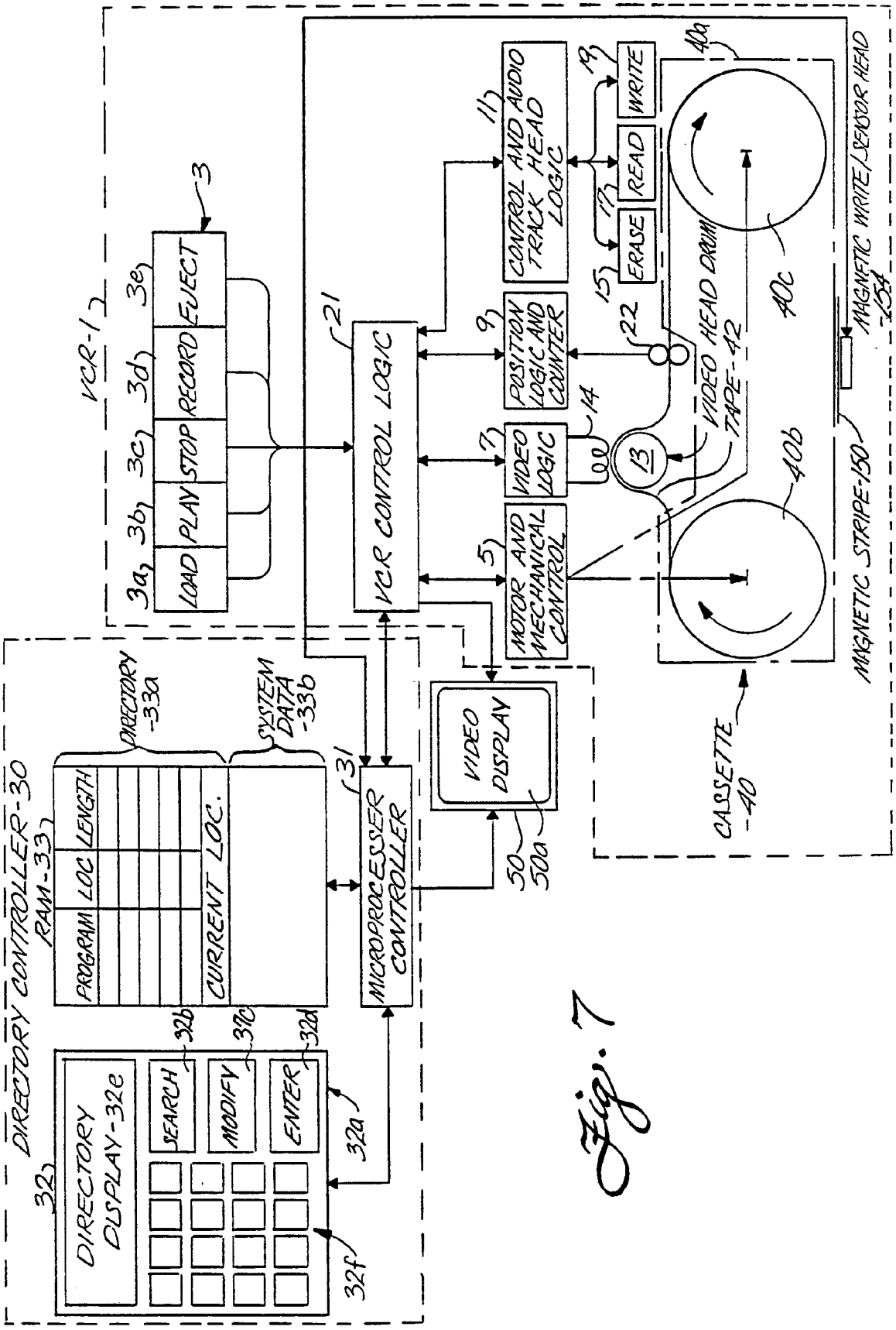

VCR-1
LOAD
PLAY
STOP
RECORD
EJECT
3a
3b
3c
3d
3e
3
VCR CONTROL LOGIC
21
MOTOR AND MECHANICAL CONTROL
5
VIDEO LOGIC
7
POSITION LOGIC AND COUNTER
9
CONTROL AND AUDIO TRACK HEAD LOGIC
11
ERASE
15
READ
17
WRITE
19
VIDEO HEAD DRUM
22
VIDEO TAPE-42
14
13
40a
40b
40c
MAGNETIC STRIPE-150
MAGNETIC WRITE/SENSOR HEAD -154
CASSETTE -40
DIRECTORY CONTROLLER-30
RAM-33
PROGRAM
LOC
LENGTH
CURRENT LOC.
DIRECTORY -33a
SYSTEM DATA -33b
MICROPROCESSER CONTROLLER
31
VIDEO DISPLAY
50
50a
32
DIRECTORY DISPLAY-32e
SEARCH
MODIFY
ENTER
32a
32b
32c
32d
32f

Fig. 7

Fig. 8

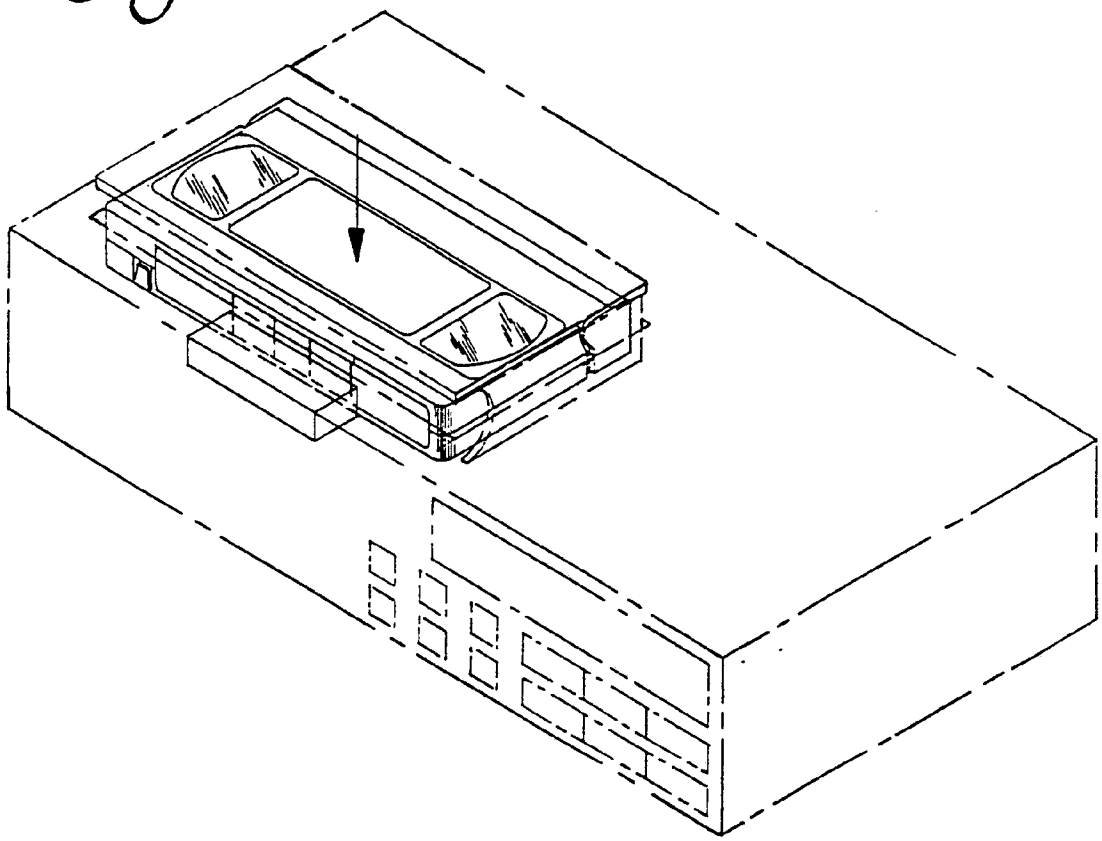


Fig. 9

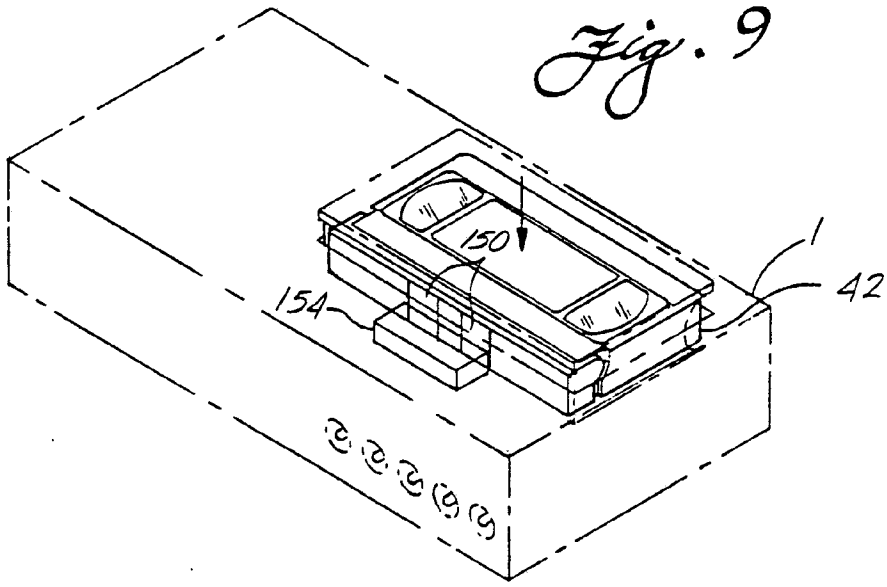


Fig. 10

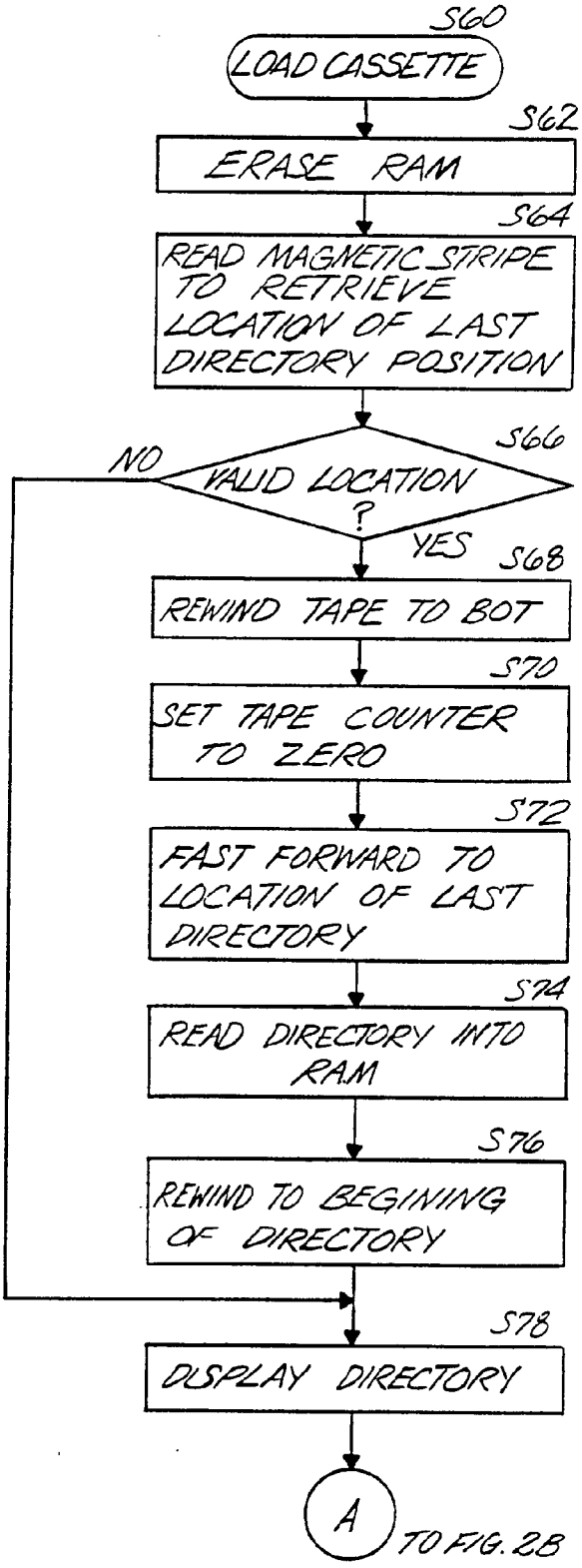
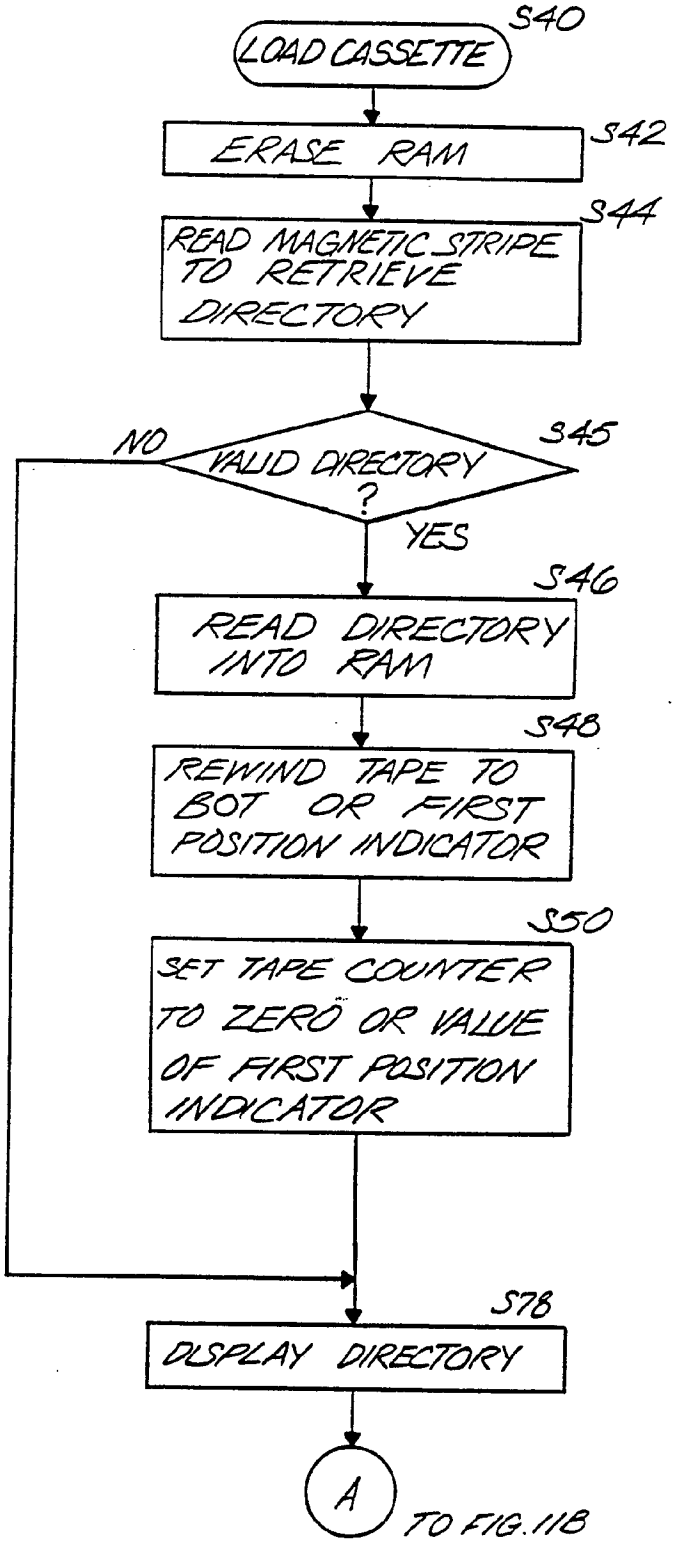

S60
LOAD CASSETTE
S62
ERASE RAM
S64
READ MAGNETIC STRIPE TO RETRIEVE LOCATION OF LAST DIRECTORY POSITION
S66
NO
VALID LOCATION ?
YES
S68
REWIND TAPE TO BOT
S70
SET TAPE COUNTER TO ZERO
S72
FAST FORWARD TO LOCATION OF LAST DIRECTORY
S74
READ DIRECTORY INTO RAM
S76
REWIND TO BEGINING OF DIRECTORY
S78
DISPLAY DIRECTORY
A
TO FIG. 2B

Fig. 11a


S40
LOAD CASSETTE
S42
ERASE RAM
S44
READ MAGNETIC STRIPE TO RETRIEVE DIRECTORY
S45
VALID DIRECTORY ?
NO
YES
S46
READ DIRECTORY INTO RAM
S48
REWIND TAPE TO BOT OR FIRST POSITION INDICATOR
S50
SET TAPE COUNTER TO ZERO OR VALUE OF FIRST POSITION INDICATOR
S78
DISPLAY DIRECTORY
A
TO FIG. 11B

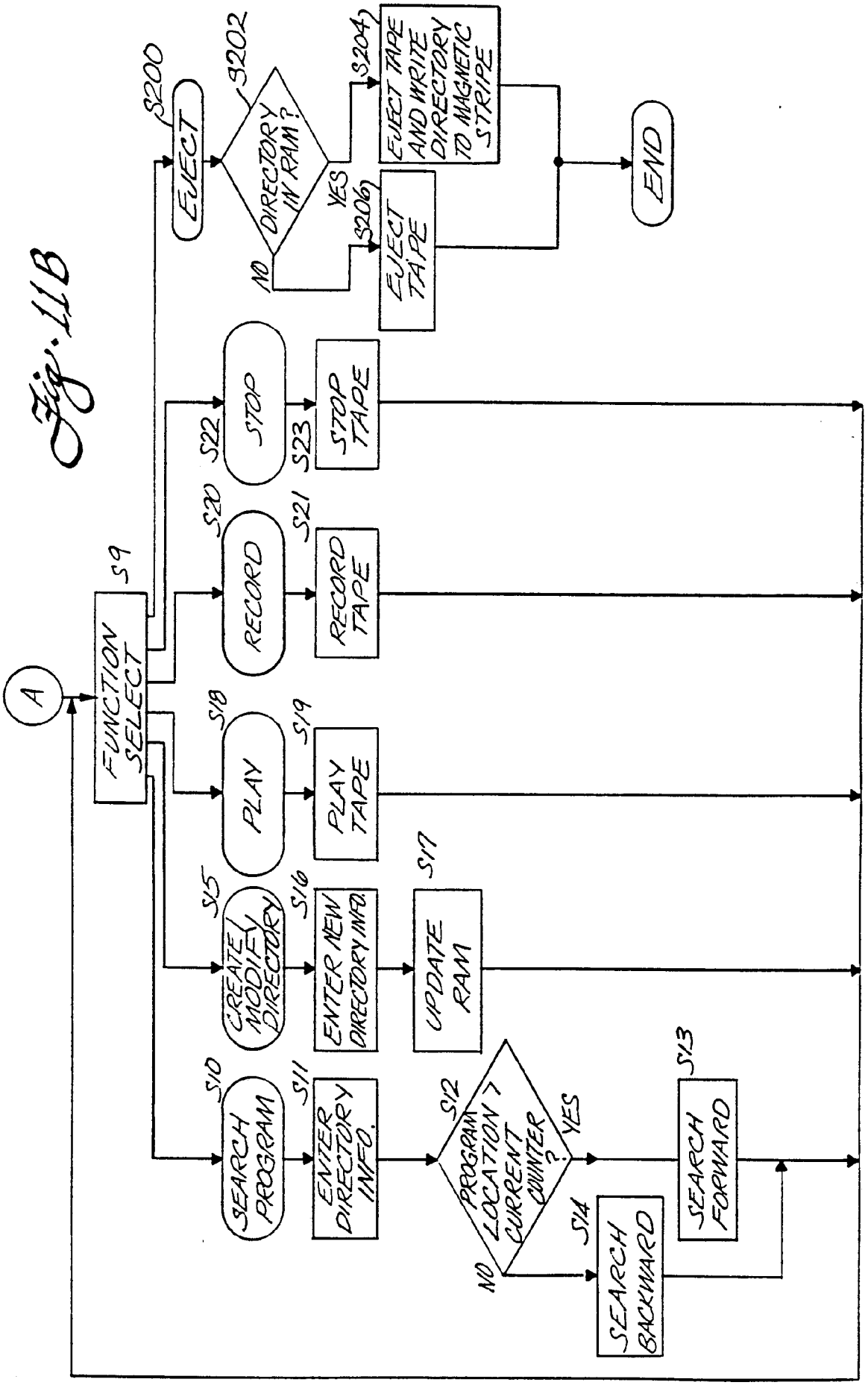

A
FUNCTION SELECT
S9
S200
EJECT
S202
DIRECTORY IN RAM?
YES
NO
S204
EJECT TAPE AND WRITE DIRECTORY TO MAGNETIC STRIPE
S206
EJECT TAPE
END
S22
STOP
S23
STOP TAPE
S20
RECORD
S21
RECORD TAPE
S18
PLAY
S19
PLAY TAPE
S15
CREATE/ MODIFY DIRECTORY
S16
ENTER NEW DIRECTORY INFO.
S17
UPDATE RAM
S10
SEARCH PROGRAM
S11
ENTER DIRECTORY INFO.
S12
PROGRAM LOCATION > CURRENT COUNTER ?
YES
NO
S13
SEARCH FORWARD
S14
SEARCH BACKWARD

Fig. 11B

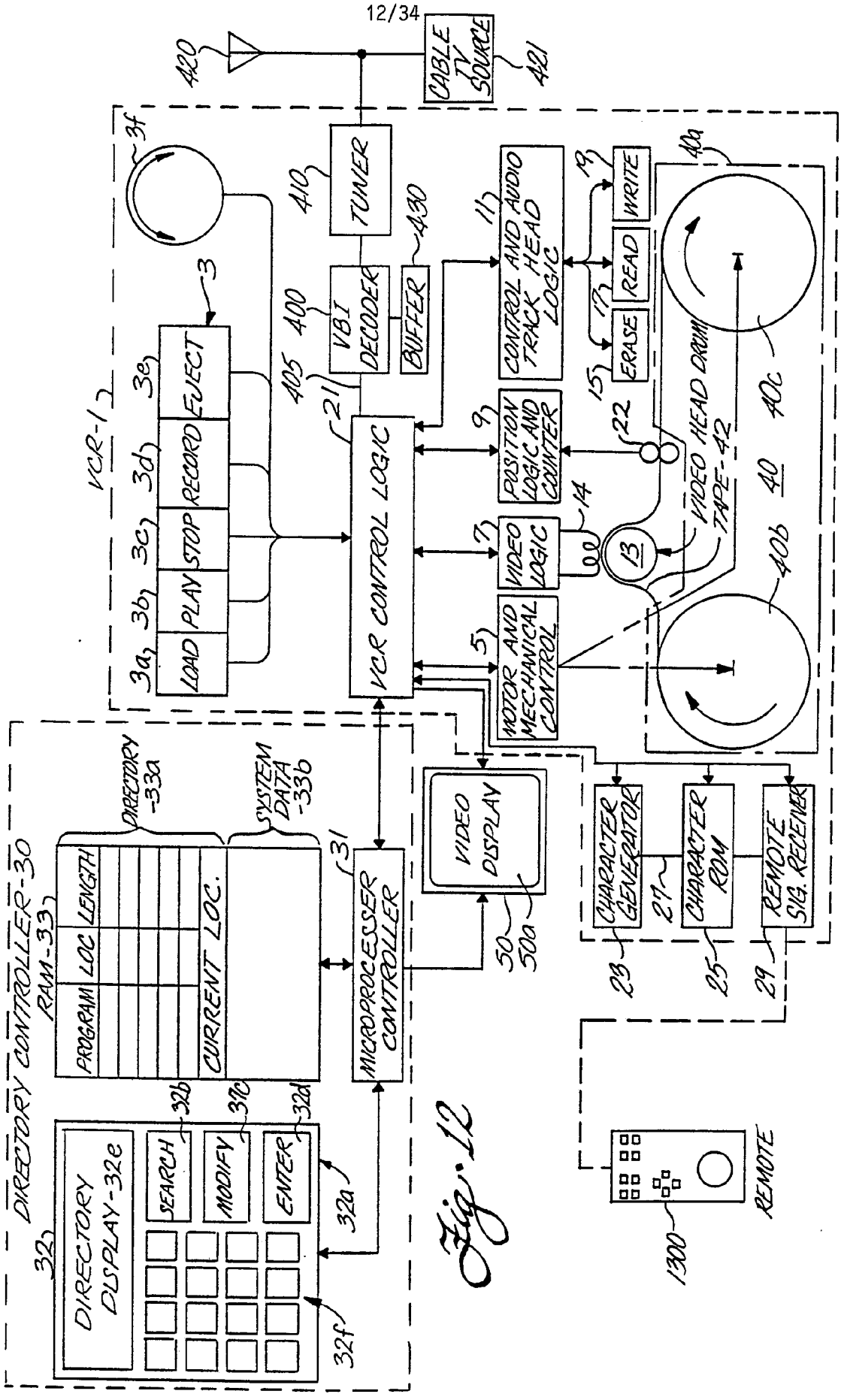

DIRECTORY CONTROLLER-30
RAM-33
PROGRAM
LOC
LENGTH
CURRENT LOC.
DIRECTORY -33a
SYSTEM DATA -33b
DIRECTORY DISPLAY-32e
SEARCH
MODIFY
ENTER
32
32a
32b
32c
32d
32f
MICROPROCESSER CONTROLLER
31
VIDEO DISPLAY
50
50a
CHARACTER GENERATOR
23
CHARACTER ROM
25
REMOTE SIG. RECEIVER
29
REMOTE
1300
VCR-1
LOAD
PLAY
STOP
RECORD
EJECT
3a
3b
3c
3d
3e
3f
3
VCR CONTROL LOGIC
21
MOTOR AND MECHANICAL CONTROL
5
VIDEO LOGIC
7
POSITION LOGIC AND COUNTER
9
CONTROL AND AUDIO TRACK HEAD LOGIC
11
VBI DECODER
400
BUFFER
430
TUNER
410
405
420
CABLE TV SOURCE
421
ERASE
15
READ
17
WRITE
19
VIDEO HEAD DRUM
40
40a
40b
40c
TAPE-42
22
14
13

Fig. 12

Fig. 13

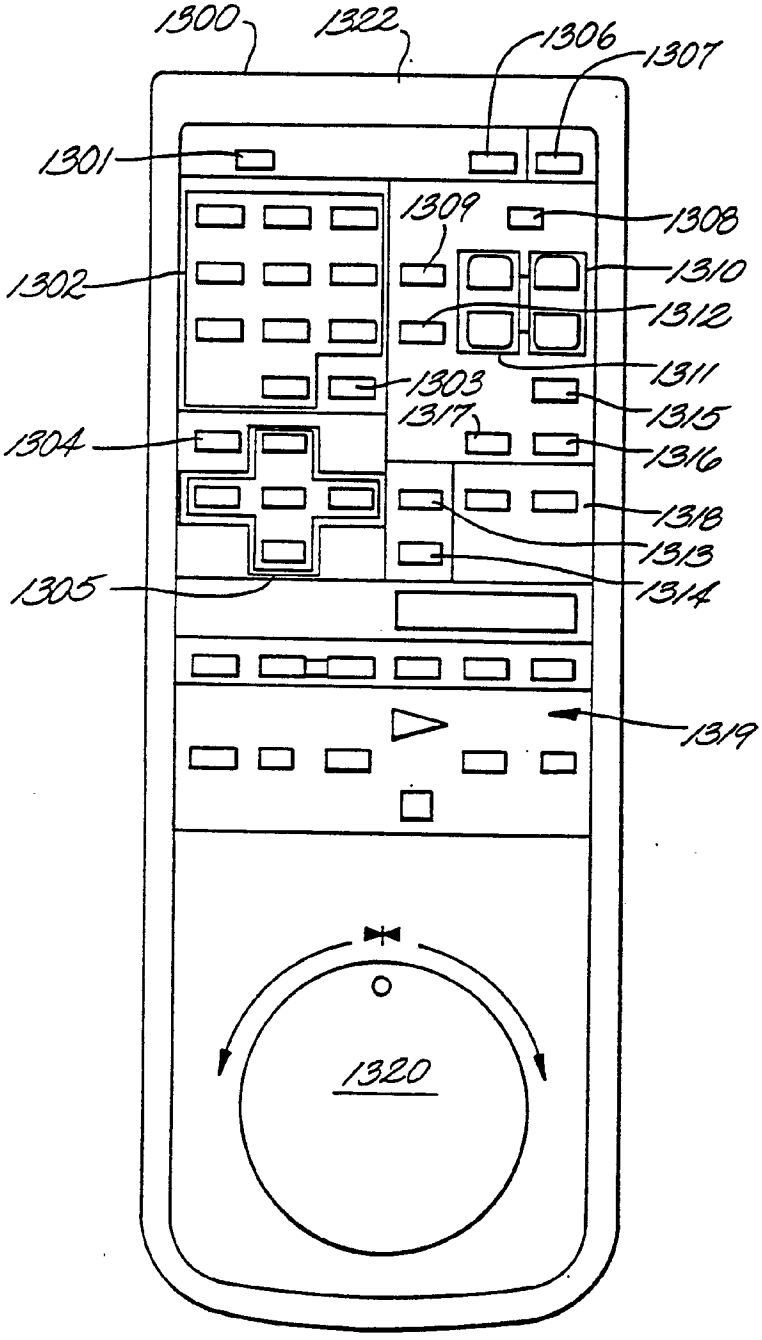

1300
1322
1306
1307
1301
1309
1308
1302
1310
1312
1311
1303
1315
1317
1304
1316
1318
1313
1305
1314
1319
1320

Fig. 14a

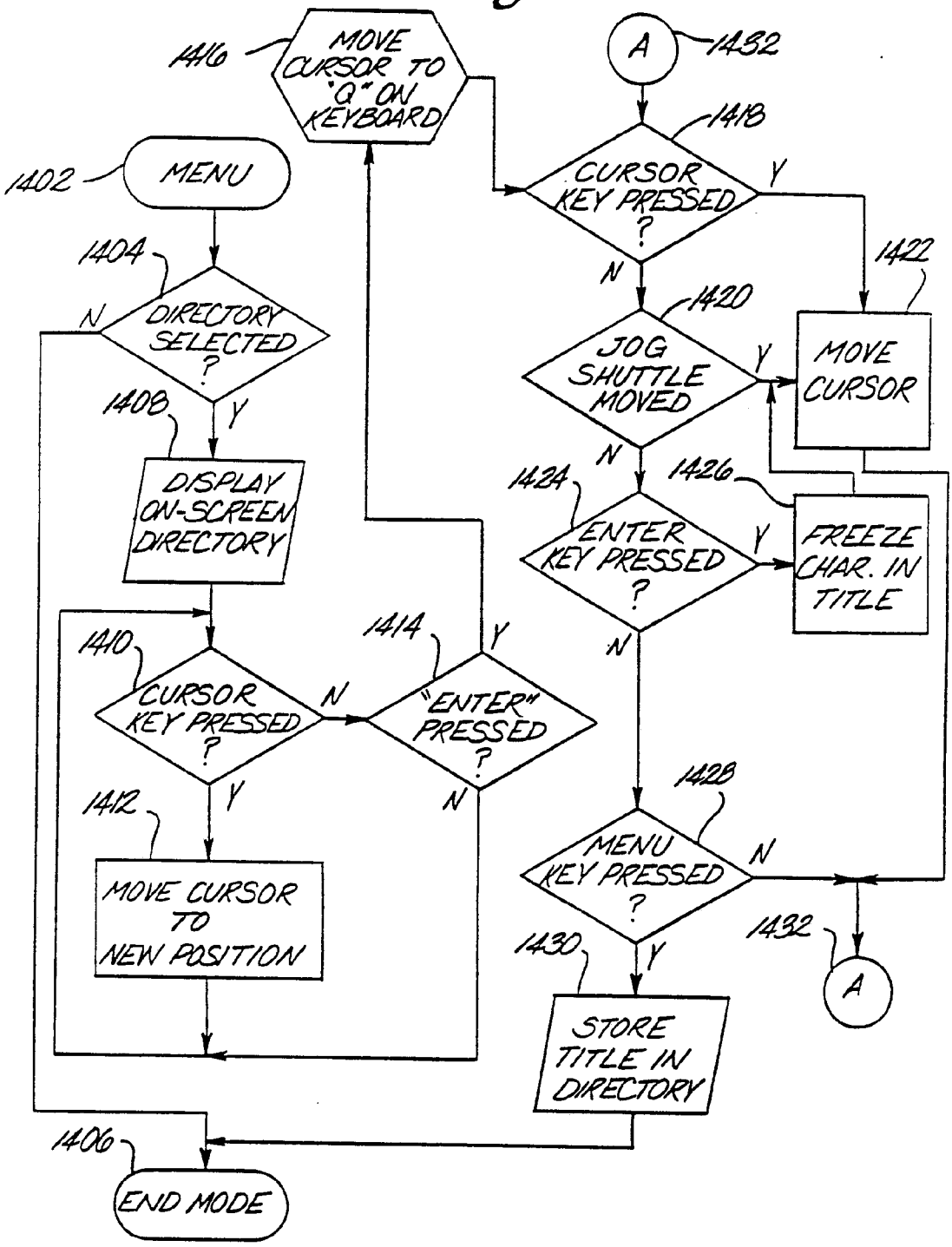

1416
MOVE CURSOR TO "Q" ON KEYBOARD
A
1432
1418
CURSOR KEY PRESSED ?
Y
N
1422
MOVE CURSOR
1420
JOG SHUTTLE MOVED
Y
N
1426
FREEZE CHAR. IN TITLE
1424
ENTER KEY PRESSED ?
Y
N
1428
MENU KEY PRESSED ?
N
Y
1430
STORE TITLE IN DIRECTORY
1432
A
1402
MENU
1404
DIRECTORY SELECTED ?
N
Y
1408
DISPLAY ON-SCREEN DIRECTORY
1410
CURSOR KEY PRESSED ?
N
Y
1414
"ENTER" PRESSED ?
Y
N
1412
MOVE CURSOR TO NEW POSITION
1406
END MODE

Fig. 14B

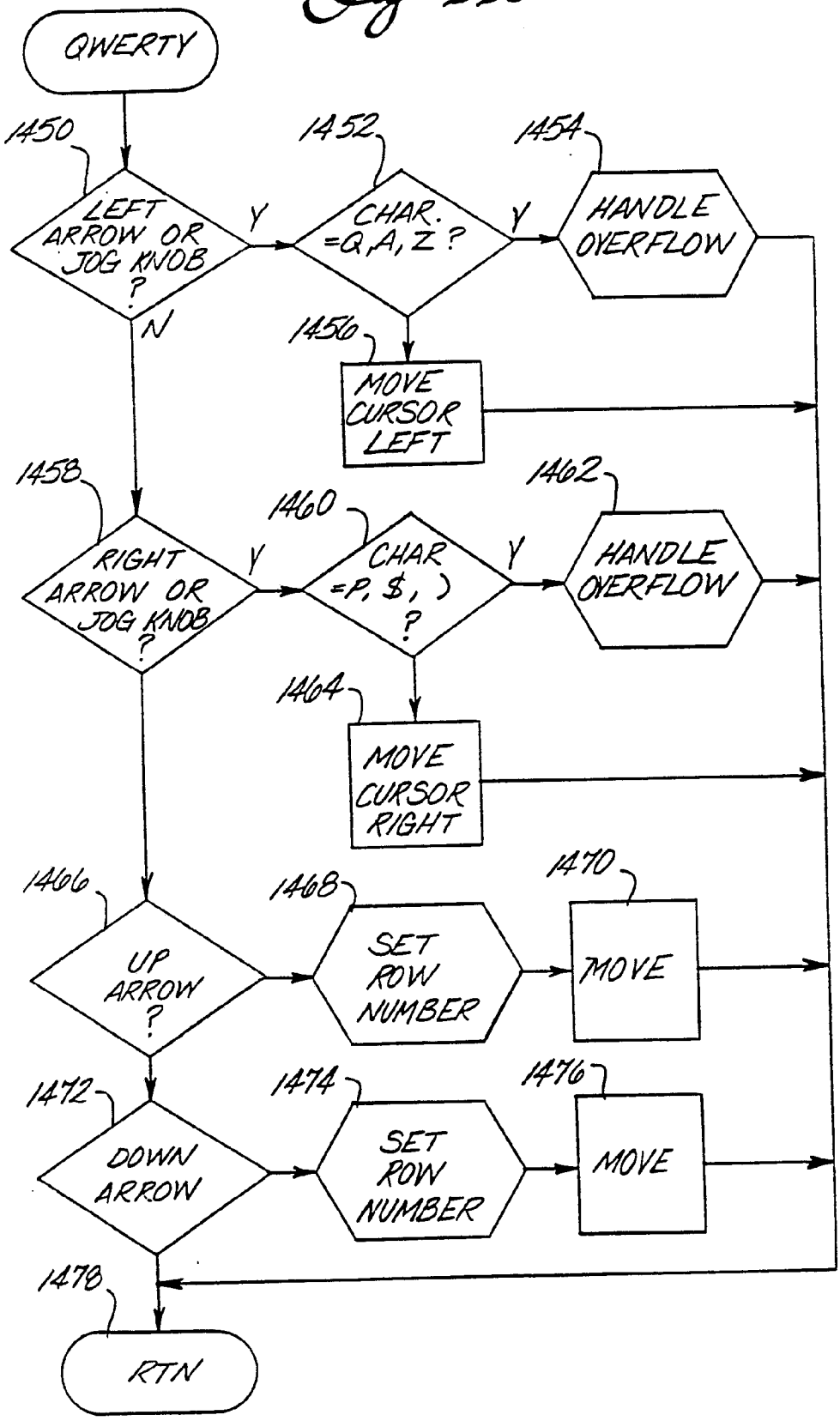

QWERTY
1450
LEFT ARROW OR JOG KNOB ?
Y
N
1452
CHAR. =Q, A, Z ?
Y
1454
HANDLE OVERFLOW
1456
MOVE CURSOR LEFT
1458
RIGHT ARROW OR JOG KNOB ?
Y
1460
CHAR =P, $,) ?
Y
1462
HANDLE OVERFLOW
1464
MOVE CURSOR RIGHT
1466
UP ARROW ?
1468
SET ROW NUMBER
1470
MOVE
1472
DOWN ARROW
1474
SET ROW NUMBER
1476
MOVE
1478
RTN

Fig. 14C

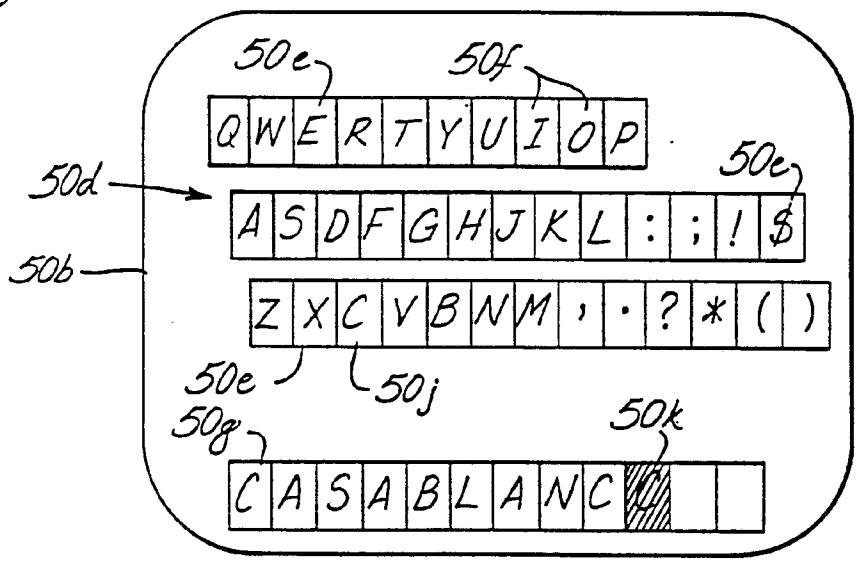


Fig. 15B

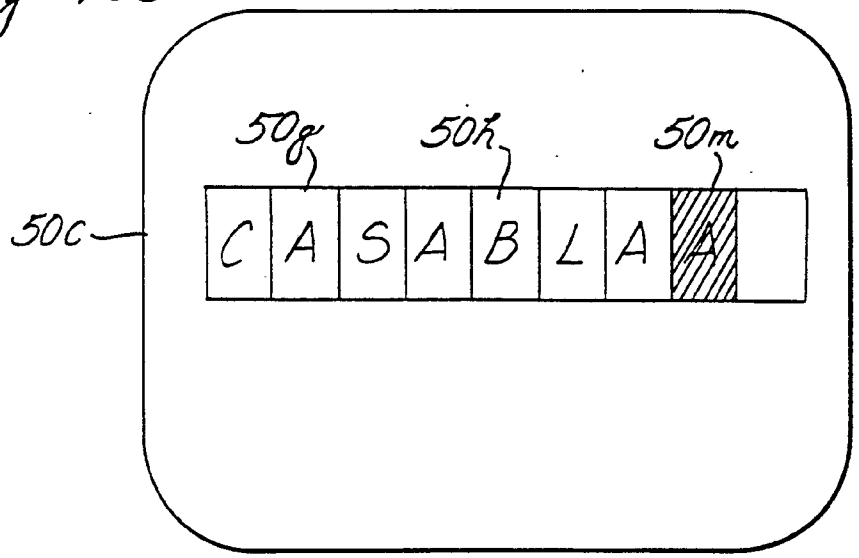


Fig. 15a

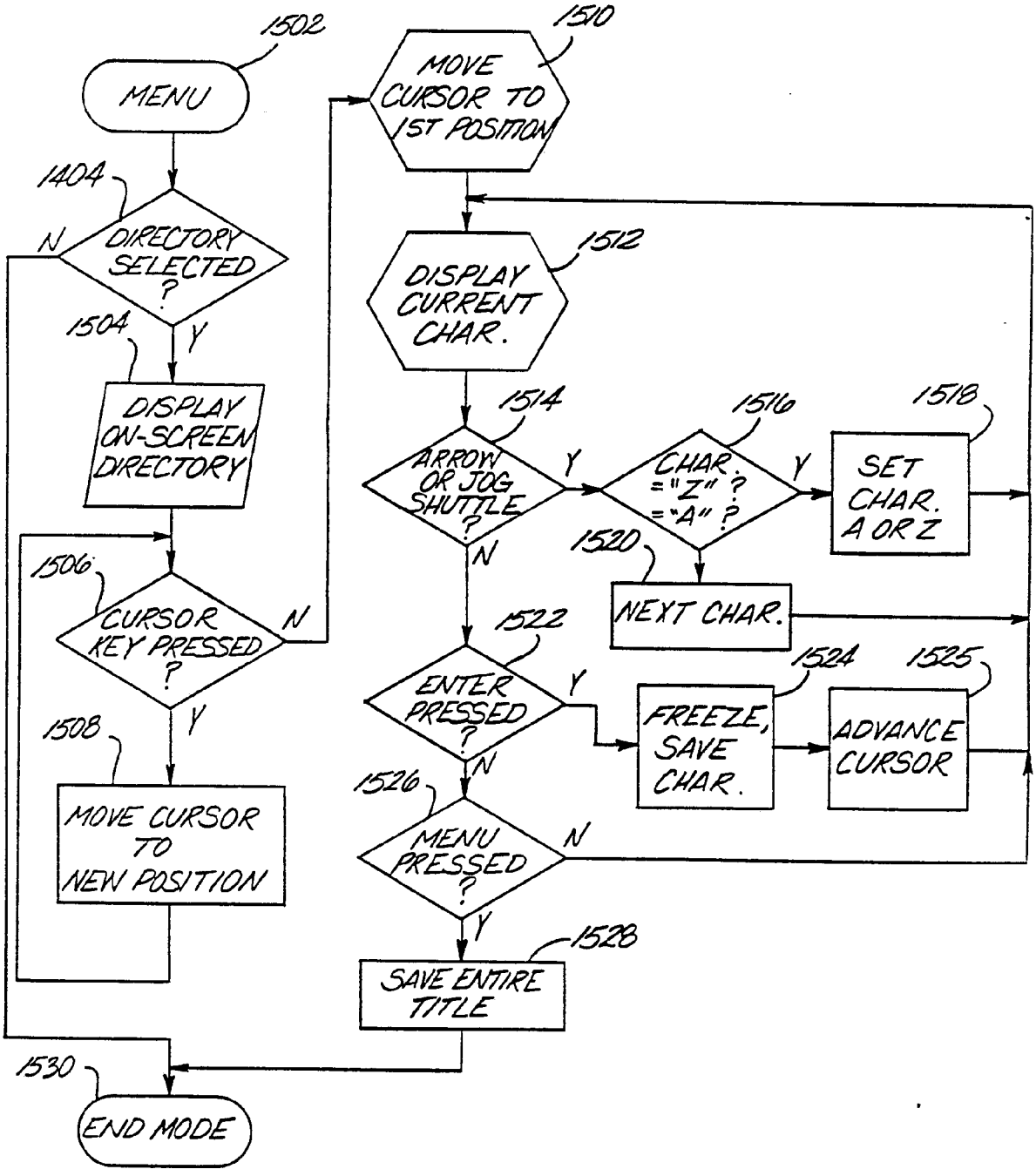

1502
MENU
1404
DIRECTORY SELECTED ?
N
Y
1504
DISPLAY ON-SCREEN DIRECTORY
1506
CURSOR KEY PRESSED ?
N
Y
1508
MOVE CURSOR TO NEW POSITION
1510
MOVE CURSOR TO 1ST POSITION
1512
DISPLAY CURRENT CHAR.
1514
ARROW OR JOG SHUTTLE ?
Y
N
1516
CHAR. = "Z" ? = "A" ?
Y
1518
SET CHAR. A OR Z
1520
NEXT CHAR.
1522
ENTER PRESSED ?
Y
N
1524
FREEZE, SAVE CHAR.
1525
ADVANCE CURSOR
1526
MENU PRESSED ?
N
Y
1528
SAVE ENTIRE TITLE
1530
END MODE

Fig. 16

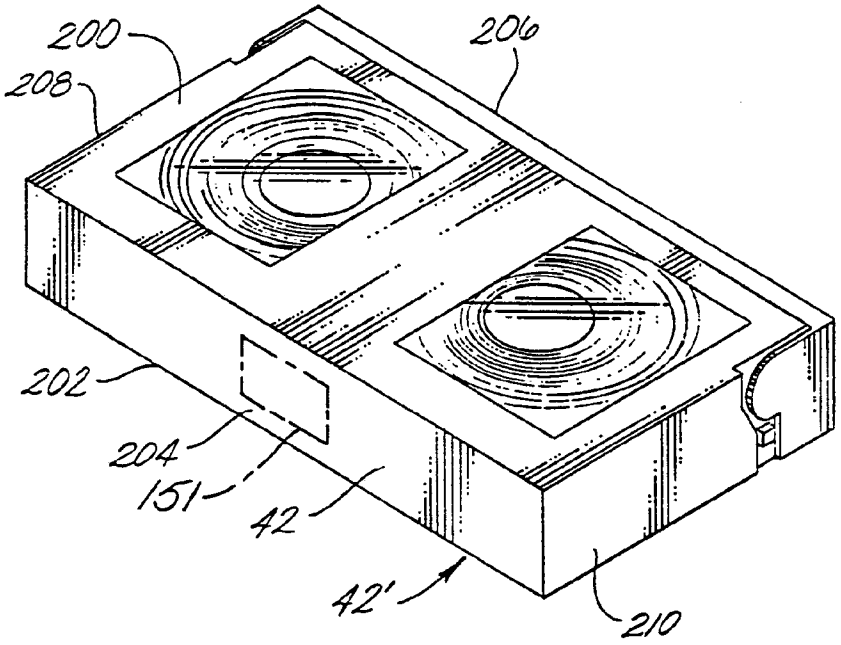
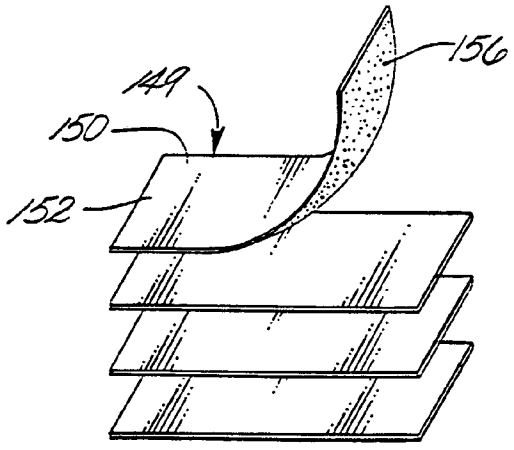


Fig. 17



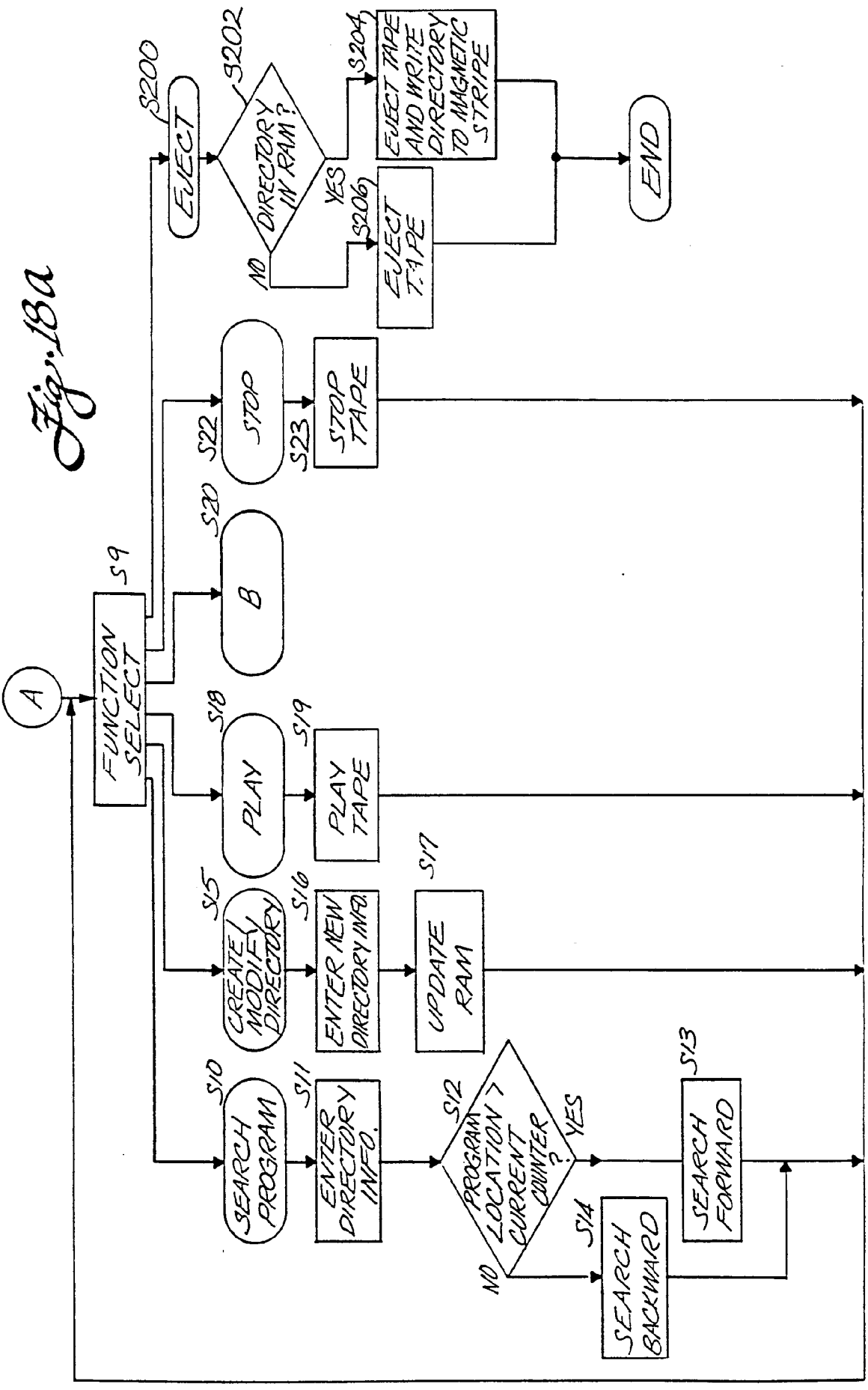

A
FUNCTION SELECT
S9
S200
EJECT
S202
DIRECTORY IN RAM ?
YES
NO
S204
EJECT TAPE AND WRITE DIRECTORY TO MAGNETIC STRIPE
S206
EJECT TAPE
END
S20
B
S22
STOP
S23
STOP TAPE
S18
PLAY
S19
PLAY TAPE
S15
CREATE/ MODIFY DIRECTORY
S16
ENTER NEW DIRECTORY INFO.
S17
UPDATE RAM
S10
SEARCH PROGRAM
S11
ENTER DIRECTORY INFO.
S12
PROGRAM LOCATION > CURRENT COUNTER ?
YES
NO
S13
SEARCH FORWARD
S14
SEARCH BACKWARD

Fig. 18a

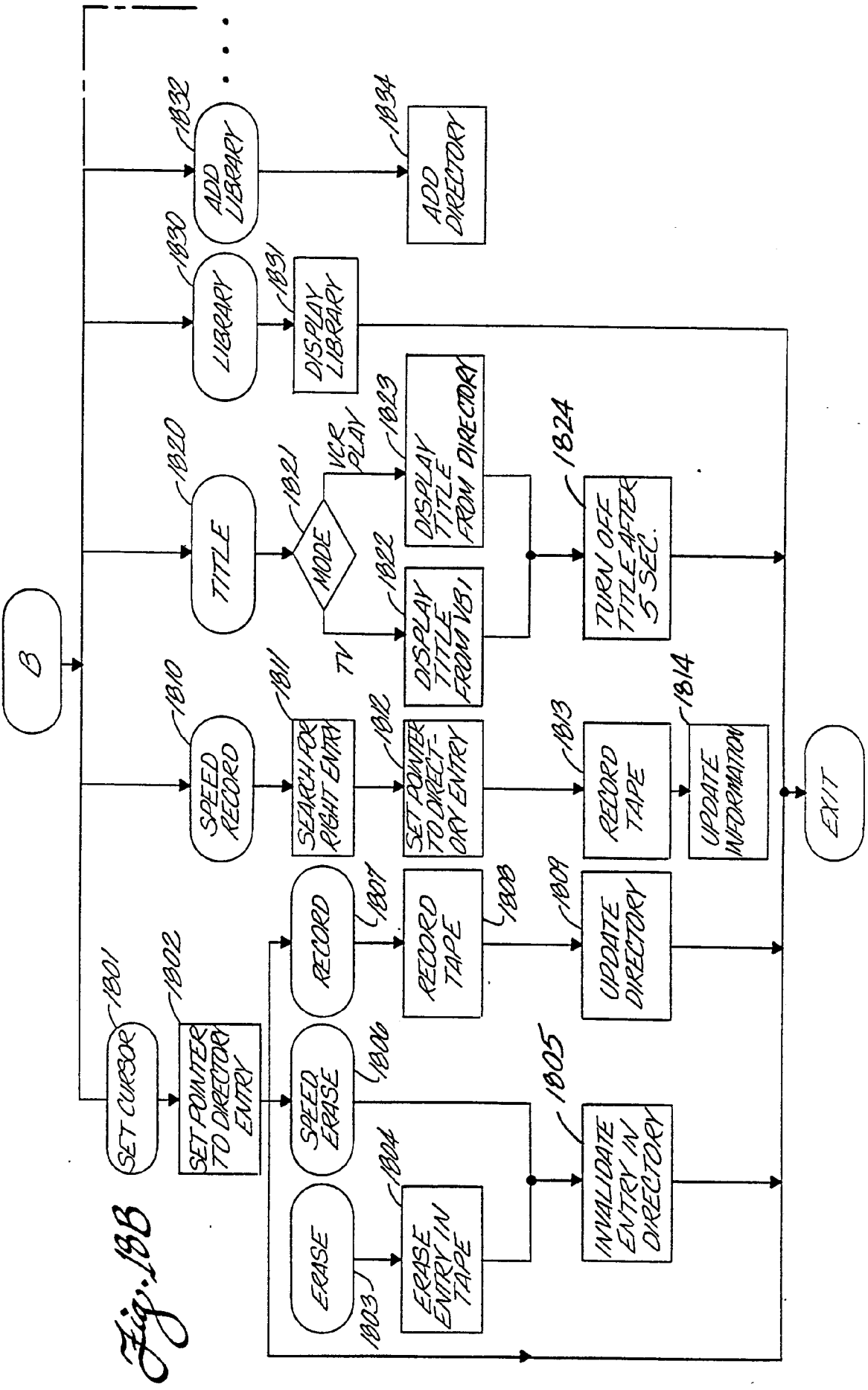

B
SET CURSOR
1801
SET POINTER TO DIRECTORY ENTRY
1802
ERASE
1803
ERASE ENTRY IN TAPE
1804
SPEED ERASE
1806
RECORD
1807
RECORD TAPE
1808
UPDATE DIRECTORY
1809
INVALIDATE ENTRY IN DIRECTORY
1805
SPEED RECORD
1810
SEARCH FOR RIGHT ENTRY
1811
SET POINTER TO DIRECT-ORY ENTRY
1812
RECORD TAPE
1813
UPDATE INFORMATION
1814
TITLE
1820
MODE
1821
TV
VCR PLAY
DISPLAY TITLE FROM VBI
1822
DISPLAY TITLE FROM DIRECTORY
1823
TURN OFF TITLE AFTER 5 SEC.
1824
LIBRARY
1830
DISPLAY LIBRARY
1831
ADD LIBRARY
1832
ADD DIRECTORY
1834
EXIT

Fig. 18B

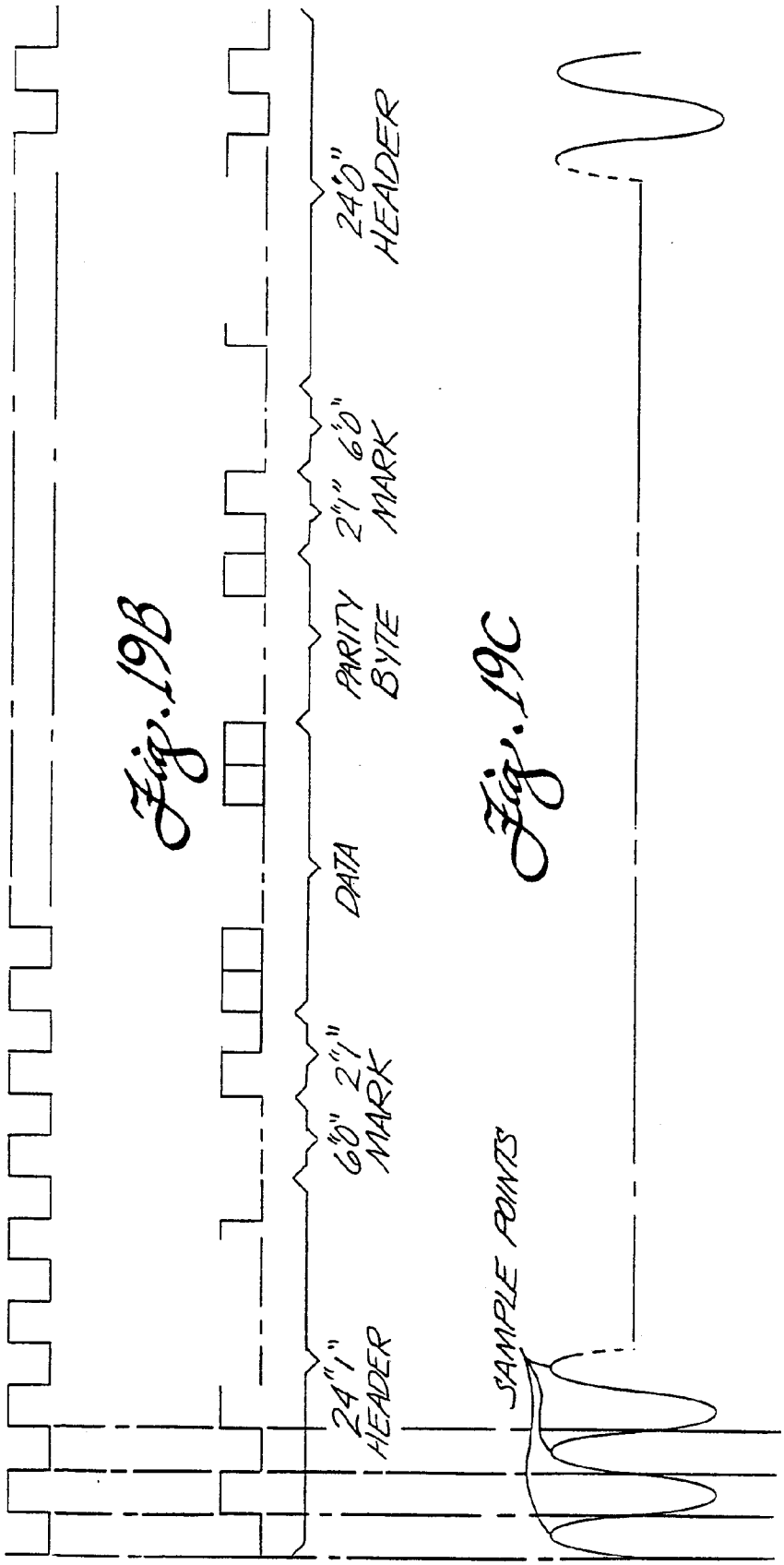


Fig. 19A

Fig. 19B

Fig. 19C

Fig. 20a

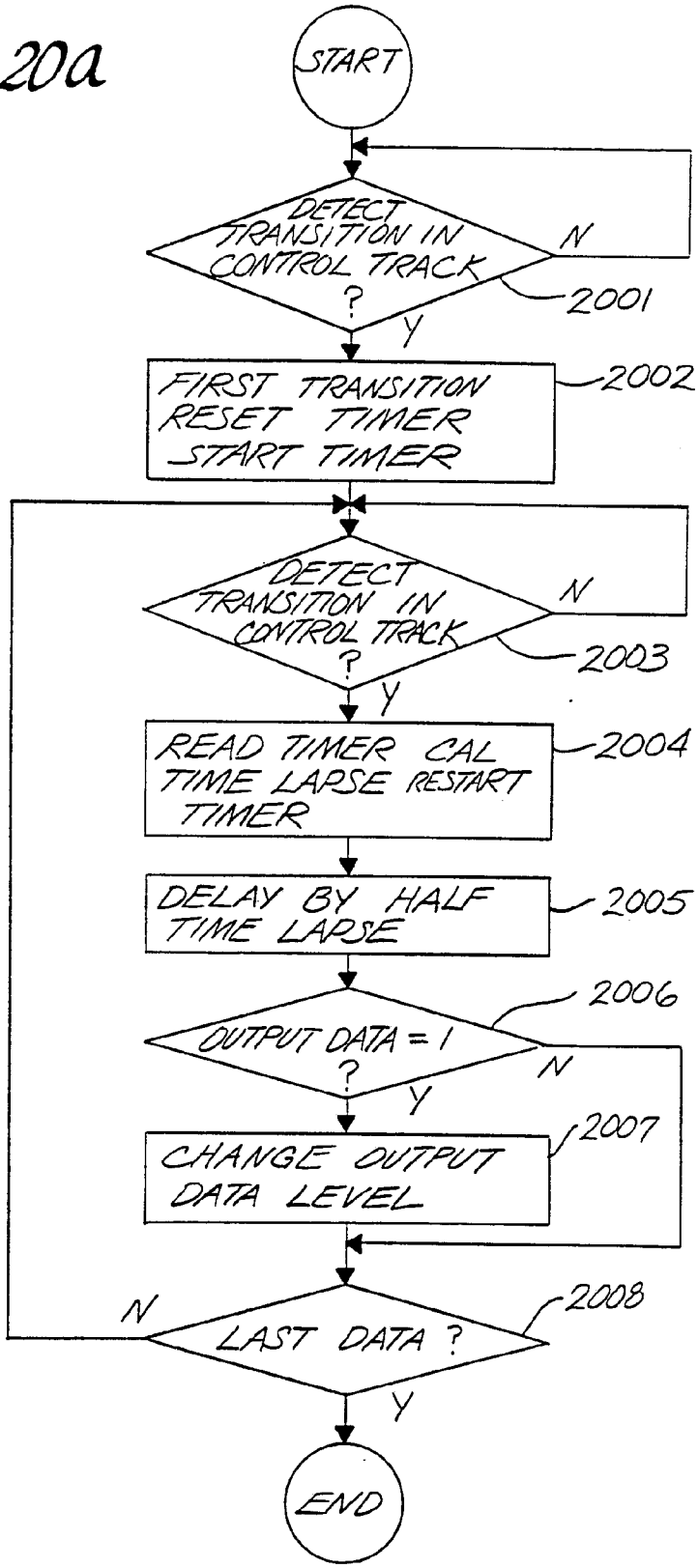

START
DETECT TRANSITION IN CONTROL TRACK ?
N
Y
2001
FIRST TRANSITION RESET TIMER START TIMER
2002
DETECT TRANSITION IN CONTROL TRACK ?
N
Y
2003
READ TIMER CAL TIME LAPSE RESTART TIMER
2004
DELAY BY HALF TIME LAPSE
2005
OUTPUT DATA = 1 ?
2006
N
Y
CHANGE OUTPUT DATA LEVEL
2007
N
LAST DATA ?
2008
Y
END

Fig. 20B

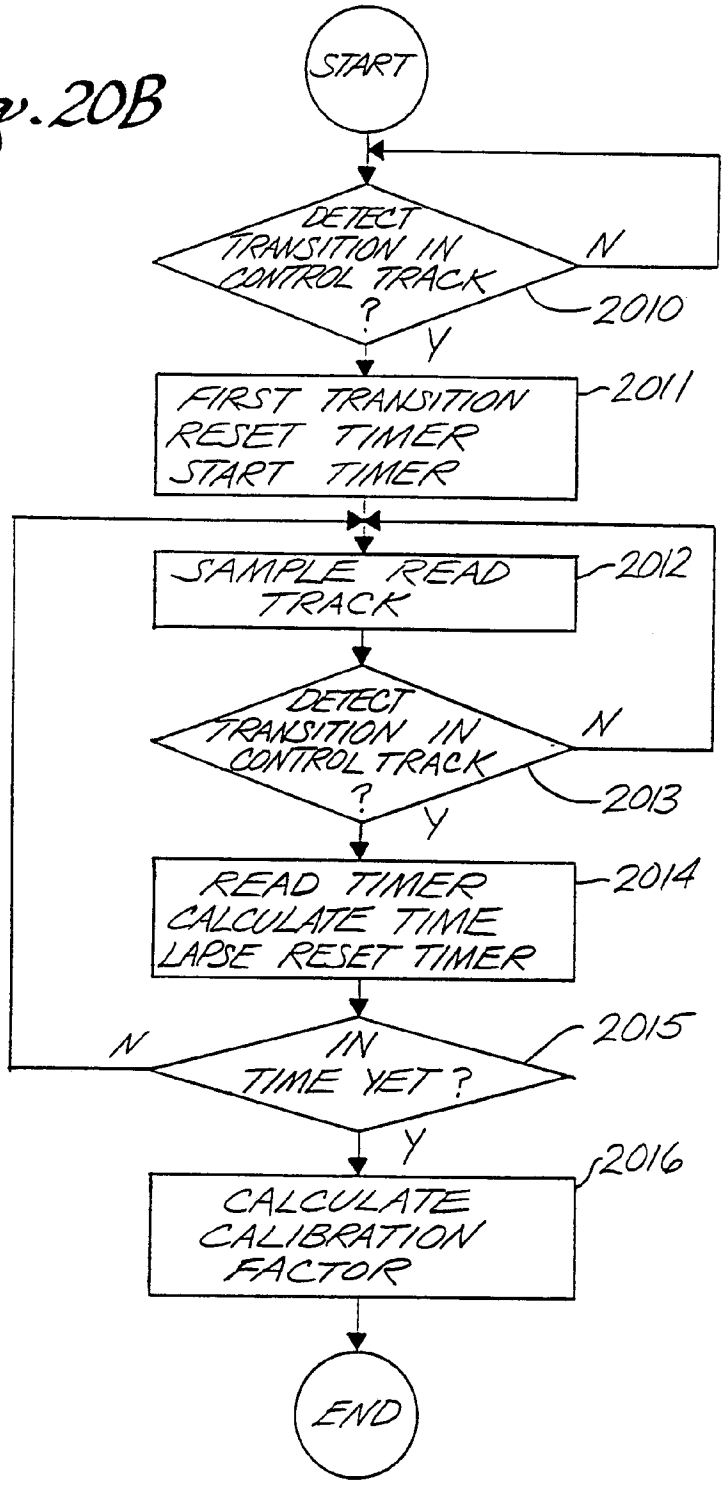

START
DETECT TRANSITION IN CONTROL TRACK ?
N
Y
2010
FIRST TRANSITION RESET TIMER START TIMER
2011
SAMPLE READ TRACK
2012
DETECT TRANSITION IN CONTROL TRACK ?
N
Y
2013
READ TIMER CALCULATE TIME LAPSE RESET TIMER
2014
IN TIME YET ?
N
Y
2015
CALCULATE CALIBRATION FACTOR
2016
END

Fig. 20C

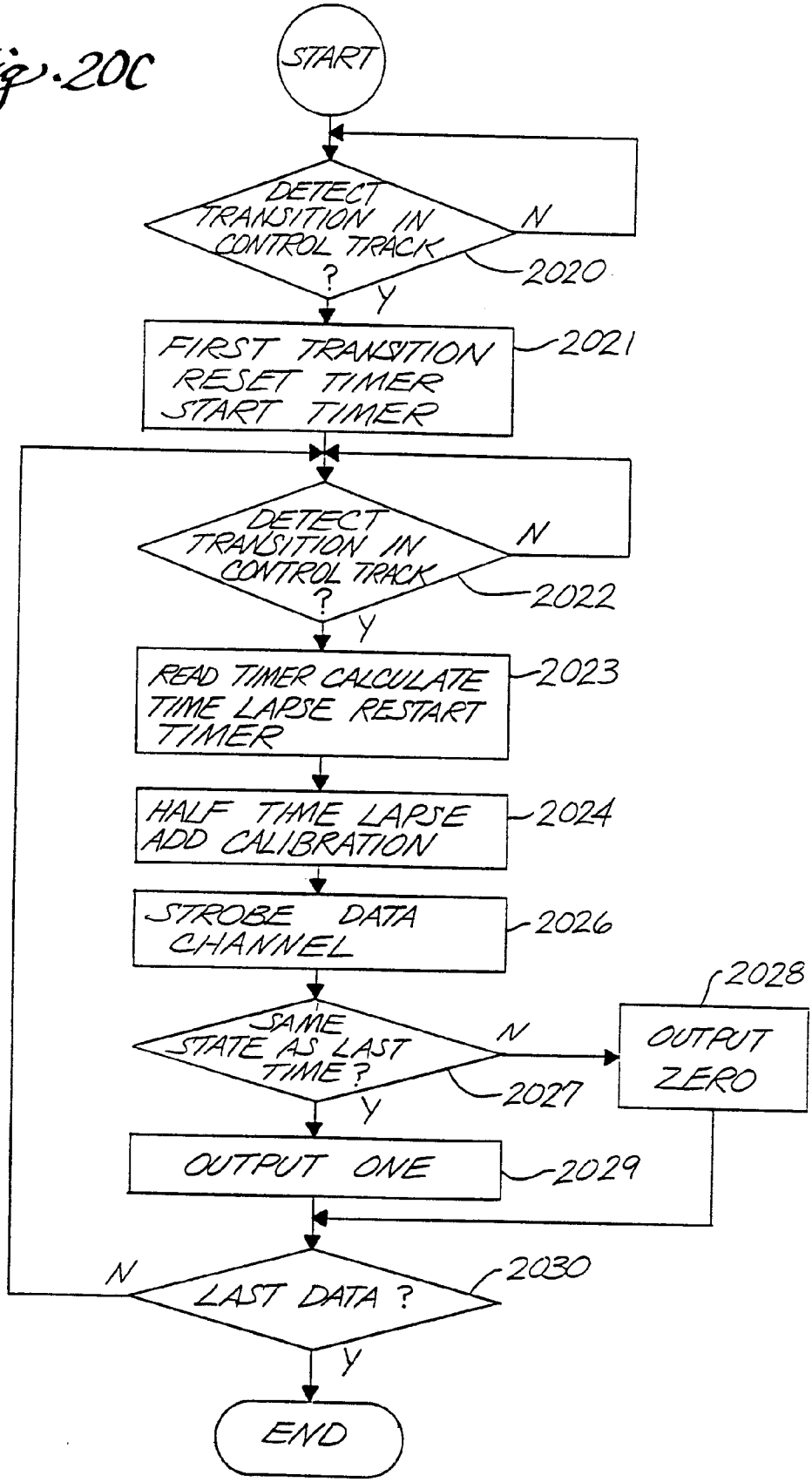

START
DETECT TRANSITION IN CONTROL TRACK ?
N
Y
2020
FIRST TRANSITION RESET TIMER START TIMER
2021
DETECT TRANSITION IN CONTROL TRACK ?
N
Y
2022
READ TIMER CALCULATE TIME LAPSE RESTART TIMER
2023
HALF TIME LAPSE ADD CALIBRATION
2024
STROBE DATA CHANNEL
2026
SAME STATE AS LAST TIME ?
N
Y
2027
2028
OUTPUT ZERO
OUTPUT ONE
2029
N
LAST DATA ?
2030
Y
END

Fig. 21

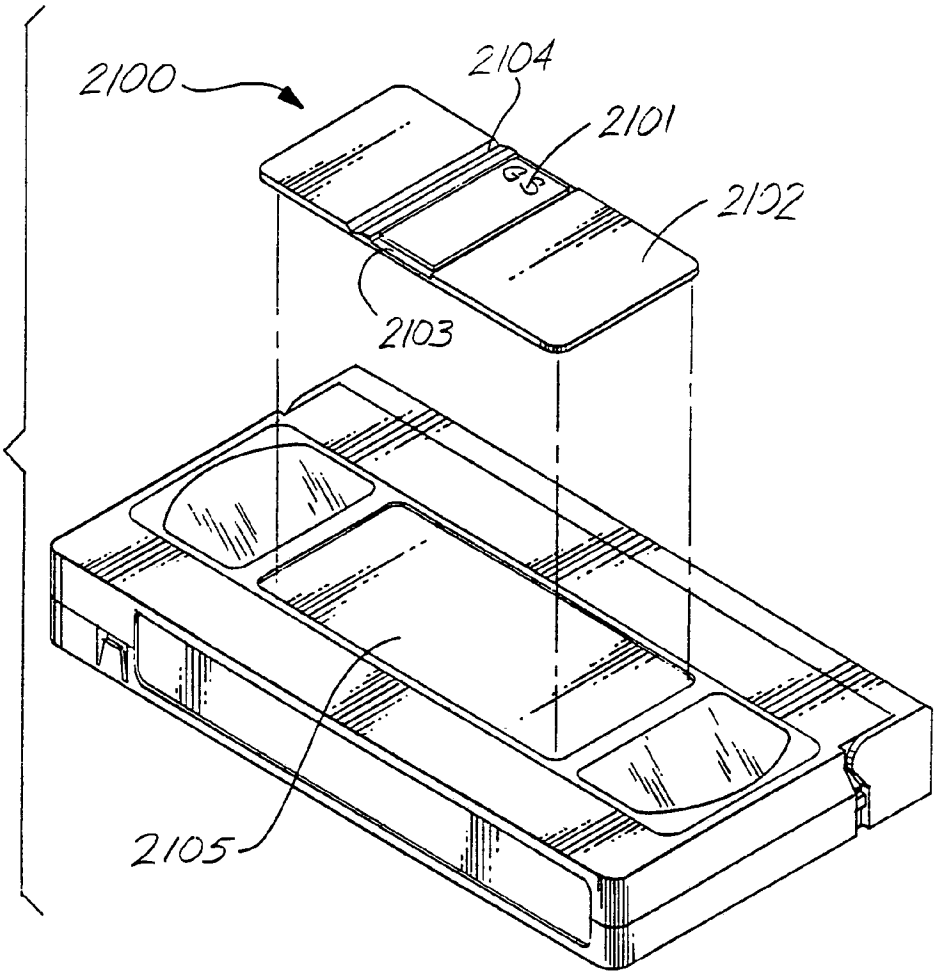


Fig. 22

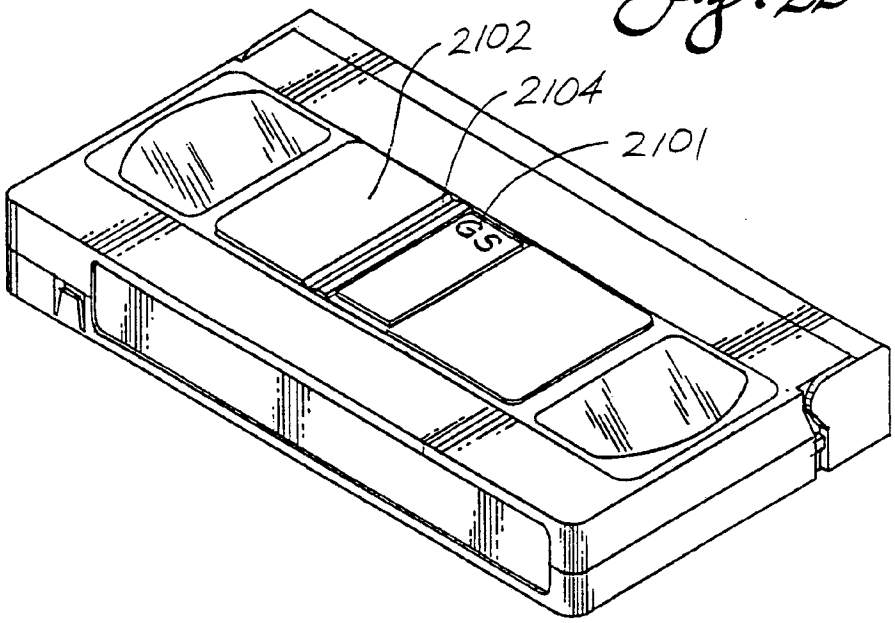


Fig. 23

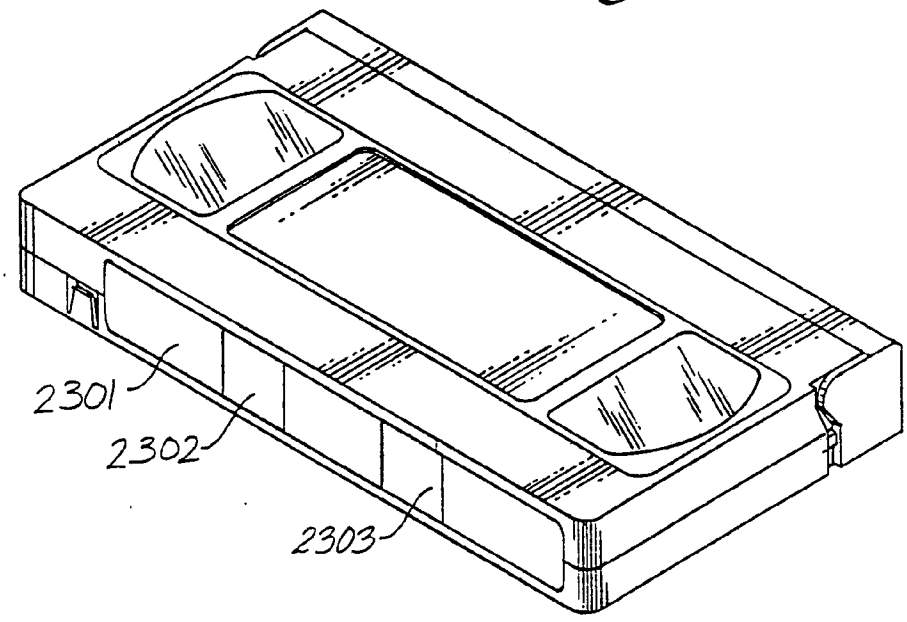


Fig. 24a

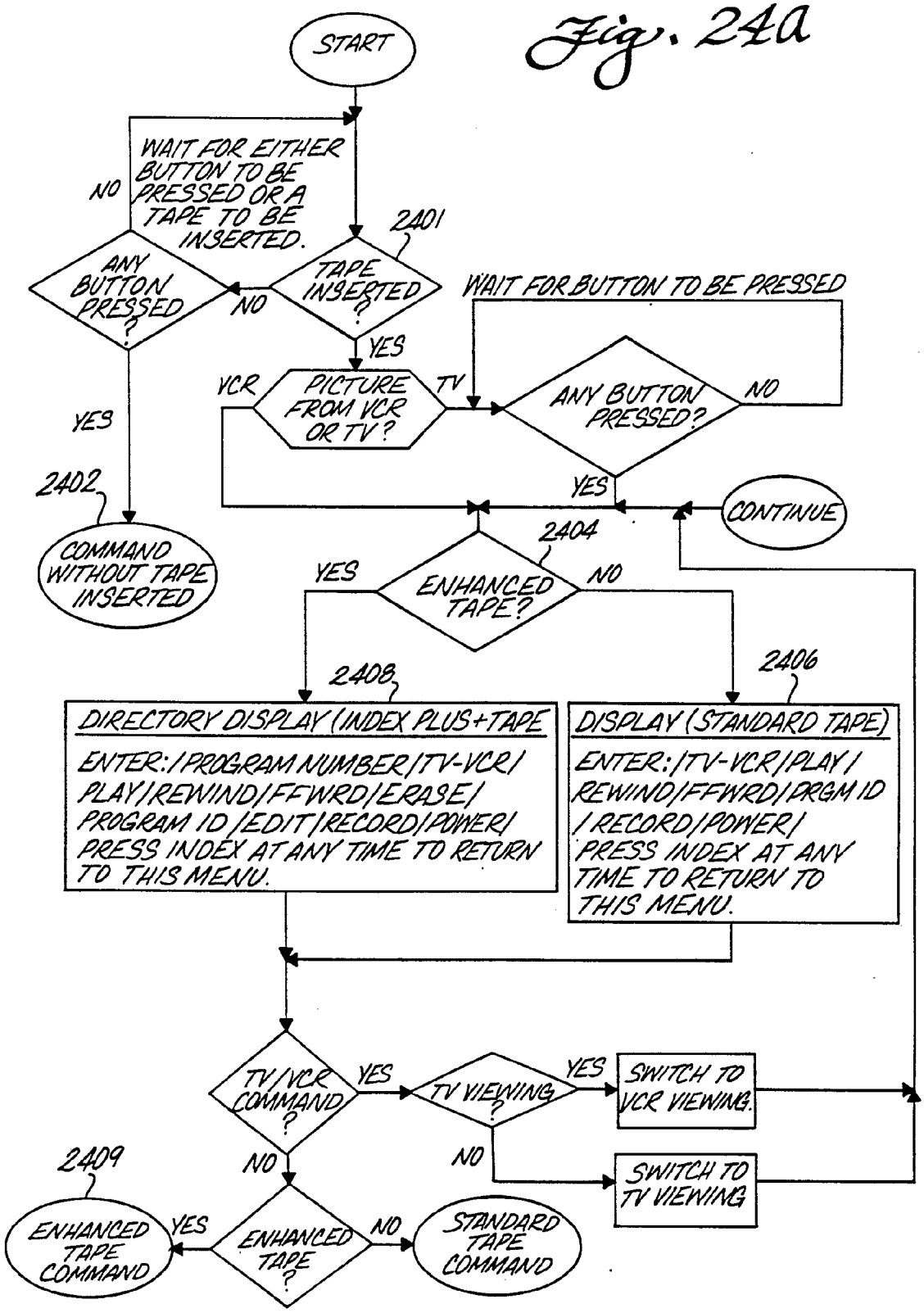

START
WAIT FOR EITHER BUTTON TO BE PRESSED OR A TAPE TO BE INSERTED.
NO
2401
TAPE INSERTED?
ANY BUTTON PRESSED?
NO
YES
WAIT FOR BUTTON TO BE PRESSED
VCR
PICTURE FROM VCR OR TV?
TV
ANY BUTTON PRESSED?
NO
YES
YES
2402
CONTINUE
COMMAND WITHOUT TAPE INSERTED
2404
YES
ENHANCED TAPE?
NO
2408
2406
DIRECTORY DISPLAY (INDEX PLUS+TAPE
ENTER:/PROGRAM NUMBER/TV-VCR/ PLAY/REWIND/FFWRD/ERASE/ PROGRAM ID/EDIT/RECORD/POWER/ PRESS INDEX AT ANY TIME TO RETURN TO THIS MENU.
DISPLAY (STANDARD TAPE)
ENTER:/TV-VCR/PLAY/ REWIND/FFWRD/PRGM ID /RECORD/POWER/ PRESS INDEX AT ANY TIME TO RETURN TO THIS MENU.
TV/VCR COMMAND?
YES
TV VIEWING?
YES
SWITCH TO VCR VIEWING.
NO
NO
SWITCH TO TV VIEWING
2409
ENHANCED TAPE COMMAND
YES
ENHANCED TAPE?
NO
STANDARD TAPE COMMAND

Fig. 24B

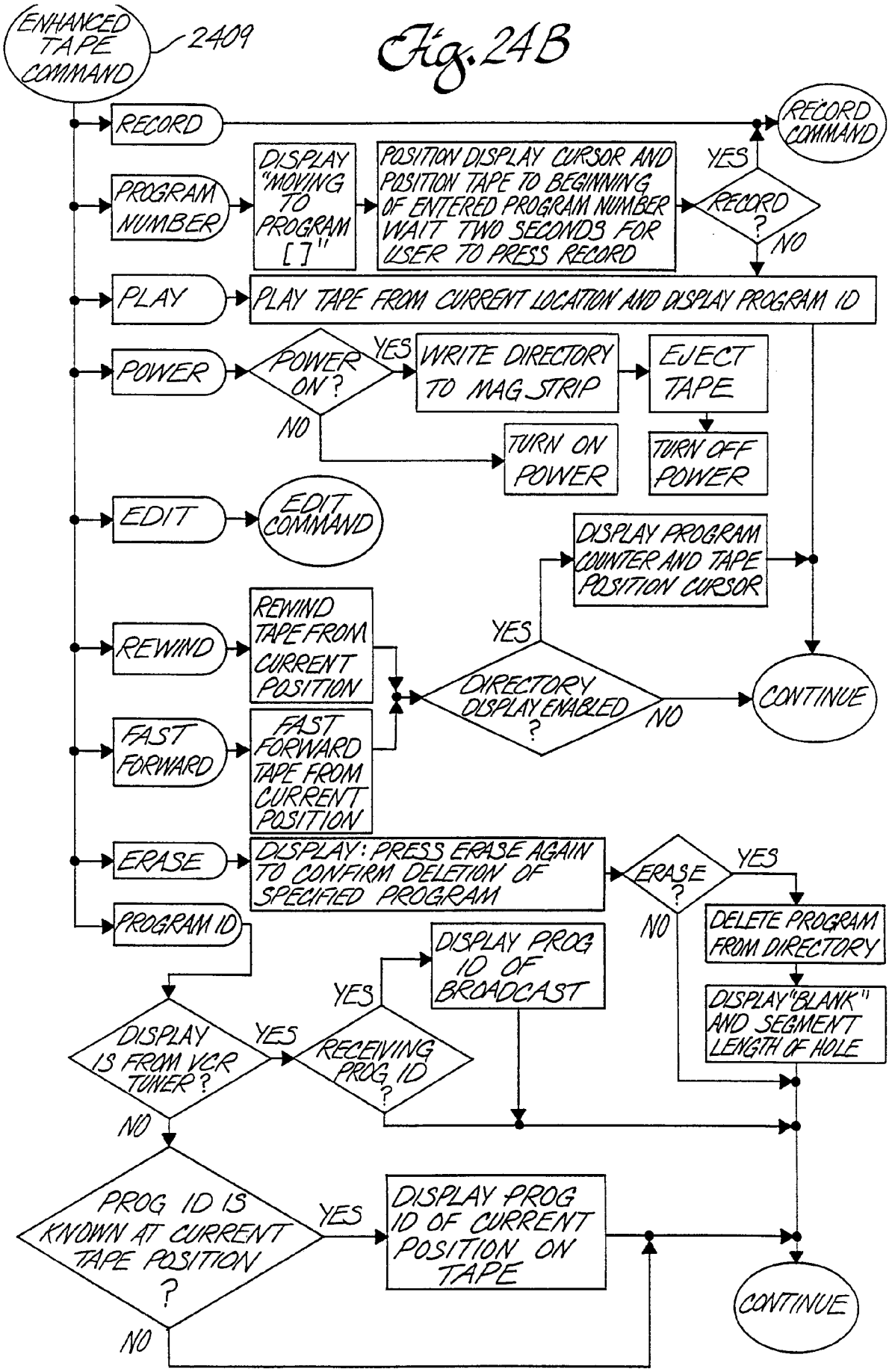
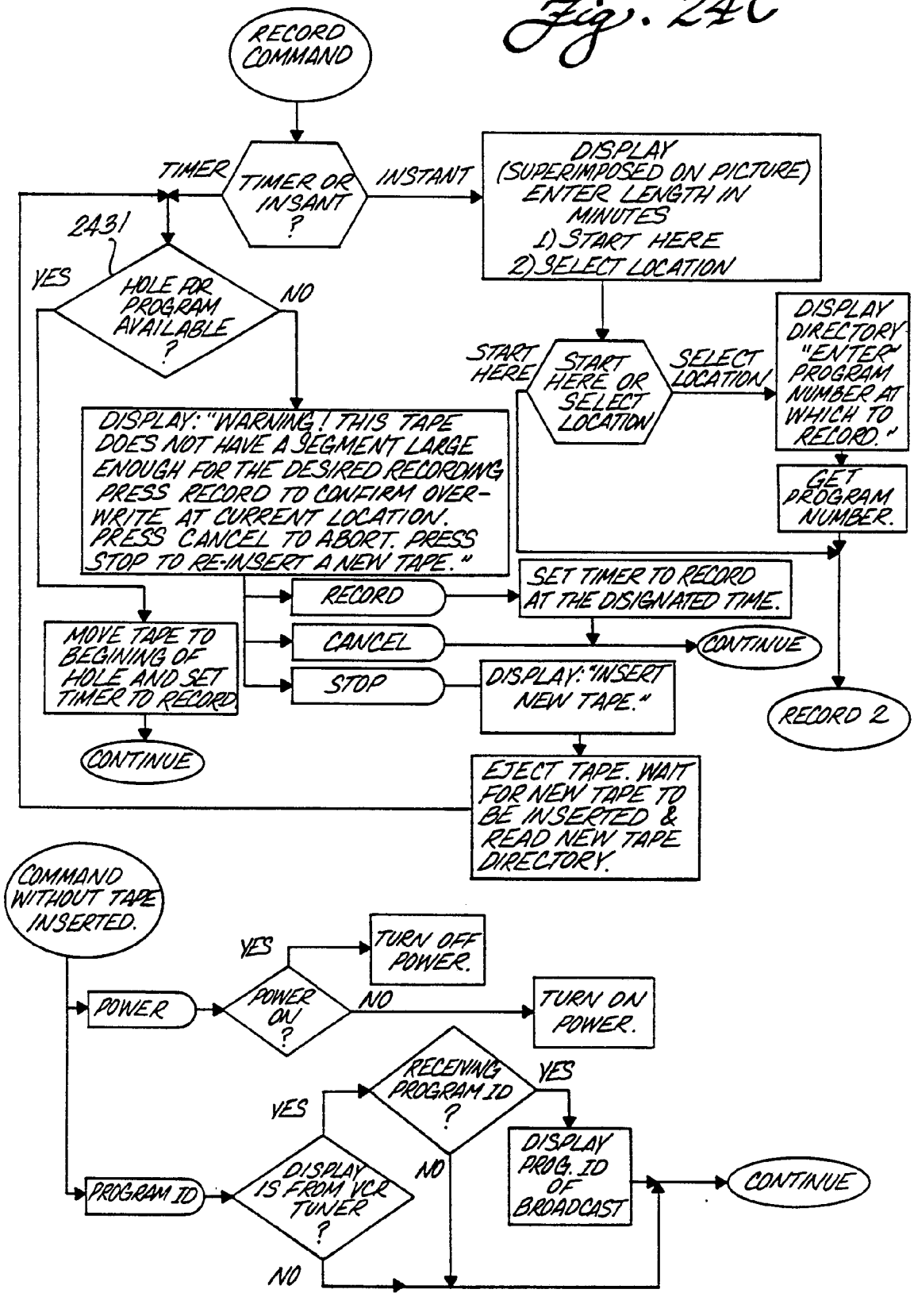

ENHANCED TAPE COMMAND
2409
RECORD
RECORD COMMAND
YES
RECORD ?
NO
PROGRAM NUMBER
DISPLAY "MOVING TO PROGRAM [ ]"
POSITION DISPLAY CURSOR AND POSITION TAPE TO BEGINNING OF ENTERED PROGRAM NUMBER WAIT TWO SECONDS FOR USER TO PRESS RECORD
PLAY
PLAY TAPE FROM CURRENT LOCATION AND DISPLAY PROGRAM ID
POWER
POWER ON ?
YES
NO
WRITE DIRECTORY TO MAG STRIP
EJECT TAPE
TURN ON POWER
TURN OFF POWER
EDIT
EDIT COMMAND
DISPLAY PROGRAM COUNTER AND TAPE POSITION CURSOR
REWIND
REWIND TAPE FROM CURRENT POSITION
FAST FORWARD
FAST FORWARD TAPE FROM CURRENT POSITION
YES
DIRECTORY DISPLAY ENABLED ?
NO
CONTINUE
ERASE
DISPLAY: PRESS ERASE AGAIN TO CONFIRM DELETION OF SPECIFIED PROGRAM
ERASE ?
YES
NO
DELETE PROGRAM FROM DIRECTORY
DISPLAY "BLANK" AND SEGMENT LENGTH OF HOLE
PROGRAM ID
DISPLAY PROG ID OF BROADCAST
YES
DISPLAY IS FROM VCR TUNER ?
YES
RECEIVING PROG ID ?
NO
PROG ID IS KNOWN AT CURRENT TAPE POSITION ?
YES
NO
DISPLAY PROG ID OF CURRENT POSITION ON TAPE
CONTINUE

Fig. 24C


RECORD COMMAND
TIMER OR INSANT ?
TIMER
INSTANT
DISPLAY (SUPERIMPOSED ON PICTURE) ENTER LENGTH IN MINUTES 1) START HERE 2) SELECT LOCATION
2431
HOLE FOR PROGRAM AVAILABLE ?
YES
NO
START HERE OR SELECT LOCATION
START HERE
SELECT LOCATION
DISPLAY DIRECTORY "ENTER" PROGRAM NUMBER AT WHICH TO RECORD."
GET PROGRAM NUMBER.
DISPLAY: "WARNING! THIS TAPE DOES NOT HAVE A SEGMENT LARGE ENOUGH FOR THE DESIRED RECORDING PRESS RECORD TO CONFIRM OVER-WRITE AT CURRENT LOCATION. PRESS CANCEL TO ABORT. PRESS STOP TO RE-INSERT A NEW TAPE."
RECORD
CANCEL
STOP
SET TIMER TO RECORD AT THE DISIGNATED TIME.
CONTINUE
DISPLAY: "INSERT NEW TAPE."
MOVE TAPE TO BEGINING OF HOLE AND SET TIMER TO RECORD.
CONTINUE
RECORD 2
EJECT TAPE. WAIT FOR NEW TAPE TO BE INSERTED & READ NEW TAPE DIRECTORY.
COMMAND WITHOUT TAPE INSERTED.
POWER
POWER ON ?
YES
NO
TURN OFF POWER.
TURN ON POWER.
PROGRAM ID
DISPLAY IS FROM VCR TUNER ?
YES
NO
RECEIVING PROGRAM ID ?
YES
NO
DISPLAY PROG. ID OF BROADCAST
CONTINUE

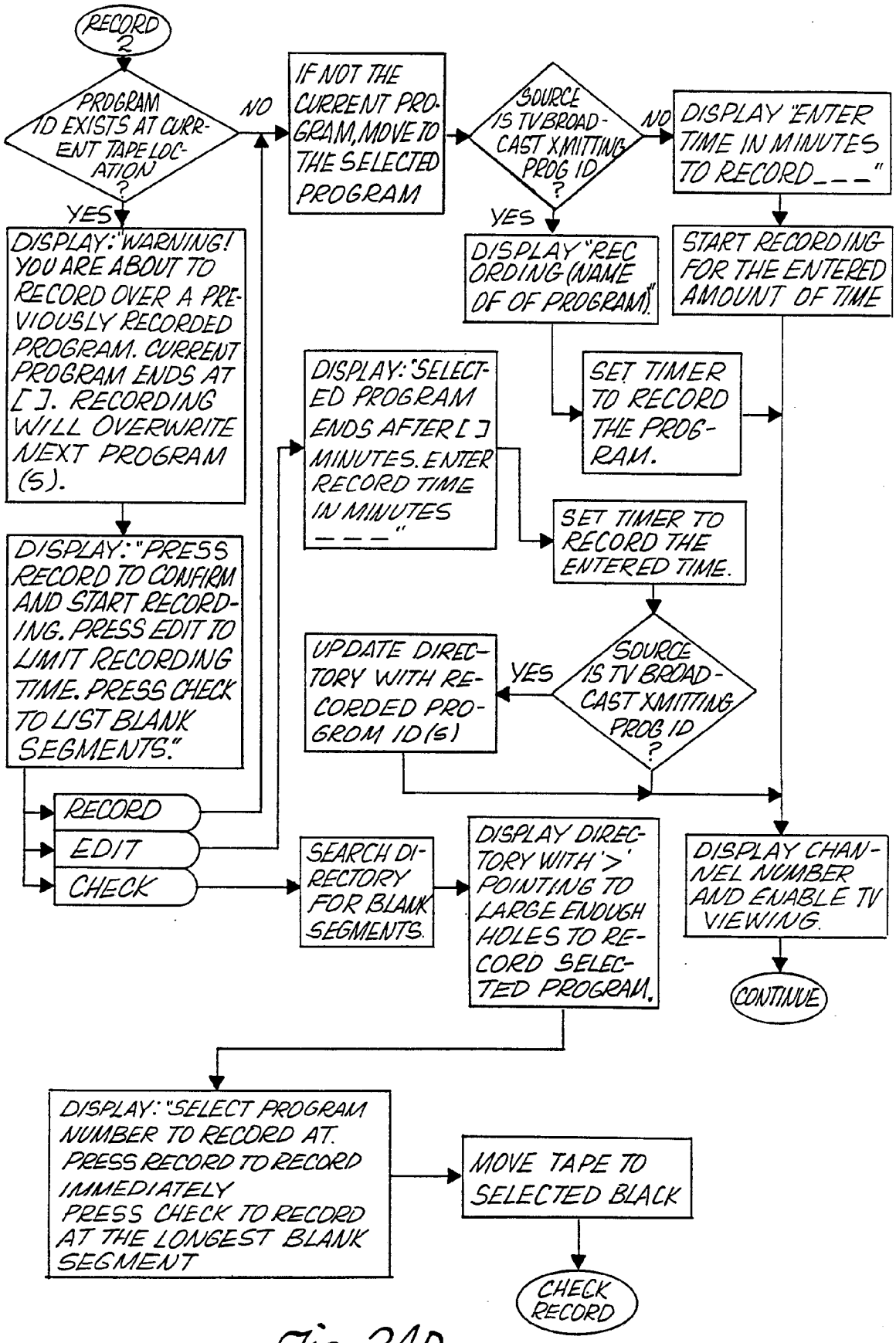

RECORD 2
PROGRAM ID EXISTS AT CURRENT TAPE LOCATION ?
NO
YES
IF NOT THE CURRENT PROGRAM, MOVE TO THE SELECTED PROGRAM
SOURCE IS TV BROADCAST XMITTING PROG ID ?
NO
YES
DISPLAY "ENTER TIME IN MINUTES TO RECORD___"
DISPLAY "RECORDING (NAME OF OF PROGRAM)"
START RECORDING FOR THE ENTERED AMOUNT OF TIME
DISPLAY: "WARNING! YOU ARE ABOUT TO RECORD OVER A PREVIOUSLY RECORDED PROGRAM. CURRENT PROGRAM ENDS AT [ ]. RECORDING WILL OVERWRITE NEXT PROGRAM (S).
DISPLAY: "SELECTED PROGRAM ENDS AFTER [ ] MINUTES. ENTER RECORD TIME IN MINUTES ___"
SET TIMER TO RECORD THE PROGRAM.
SET TIMER TO RECORD THE ENTERED TIME.
DISPLAY: "PRESS RECORD TO CONFIRM AND START RECORDING. PRESS EDIT TO LIMIT RECORDING TIME. PRESS CHECK TO LIST BLANK SEGMENTS."
SOURCE IS TV BROADCAST XMITTING PROG ID ?
YES
UPDATE DIRECTORY WITH RECORDED PROGROM ID(S)
RECORD
EDIT
CHECK
SEARCH DIRECTORY FOR BLANK SEGMENTS.
DISPLAY DIRECTORY WITH '>' POINTING TO LARGE ENOUGH HOLES TO RECORD SELECTED PROGRAM.
DISPLAY CHANNEL NUMBER AND ENABLE TV VIEWING.
CONTINUE
DISPLAY: "SELECT PROGRAM NUMBER TO RECORD AT. PRESS RECORD TO RECORD IMMEDIATELY PRESS CHECK TO RECORD AT THE LONGEST BLANK SEGMENT
MOVE TAPE TO SELECTED BLACK
CHECK RECORD

Fig. 24D

Fig. 24E

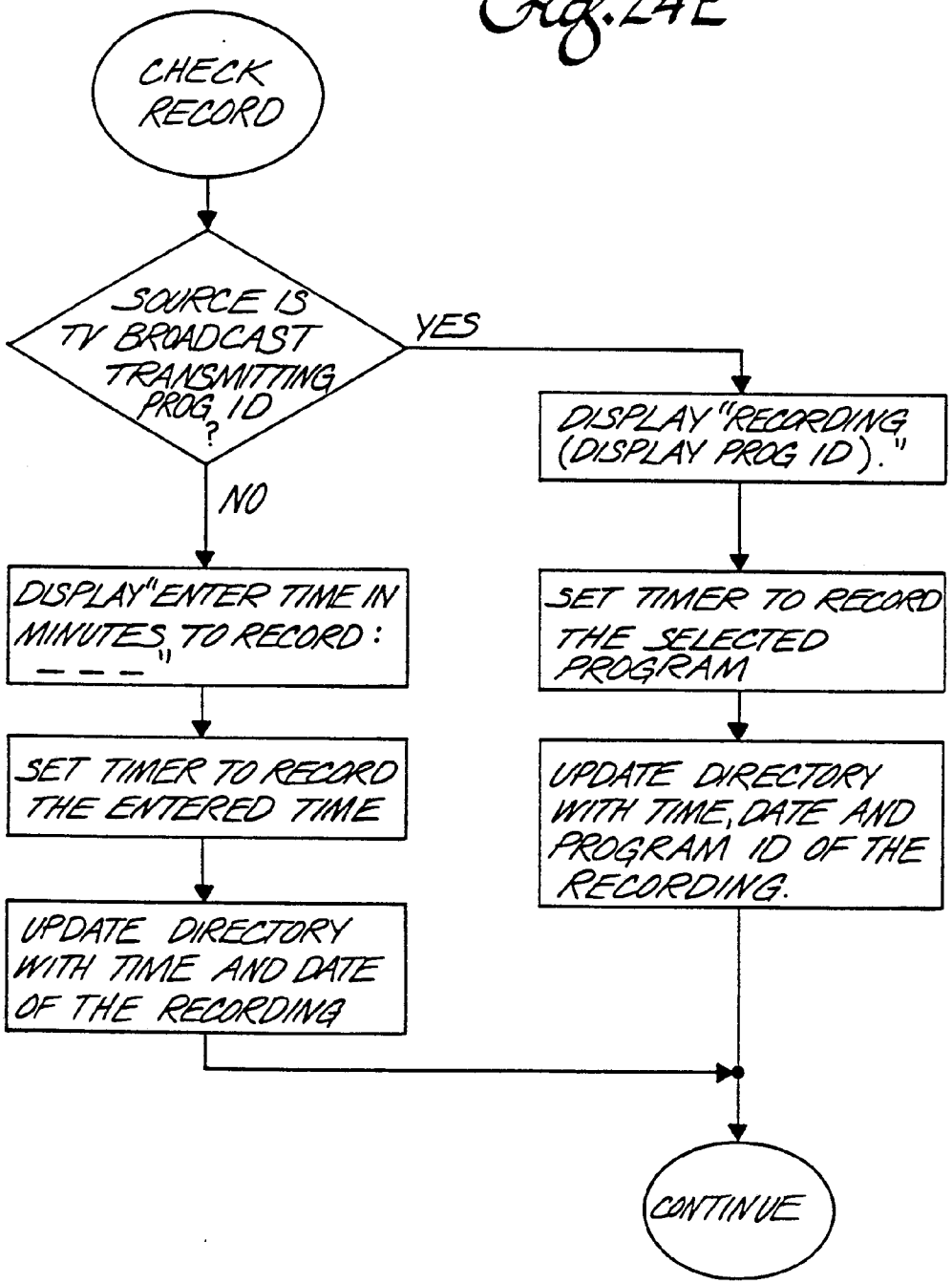

CHECK RECORD
SOURCE IS TV BROADCAST TRANSMITTING PROG. ID ?
YES
NO
DISPLAY "RECORDING (DISPLAY PROG ID)."
DISPLAY "ENTER TIME IN MINUTES TO RECORD: ___"
SET TIMER TO RECORD THE SELECTED PROGRAM
SET TIMER TO RECORD THE ENTERED TIME
UPDATE DIRECTORY WITH TIME, DATE AND PROGRAM ID OF THE RECORDING.
UPDATE DIRECTORY WITH TIME AND DATE OF THE RECORDING
CONTINUE

Fig. 24F

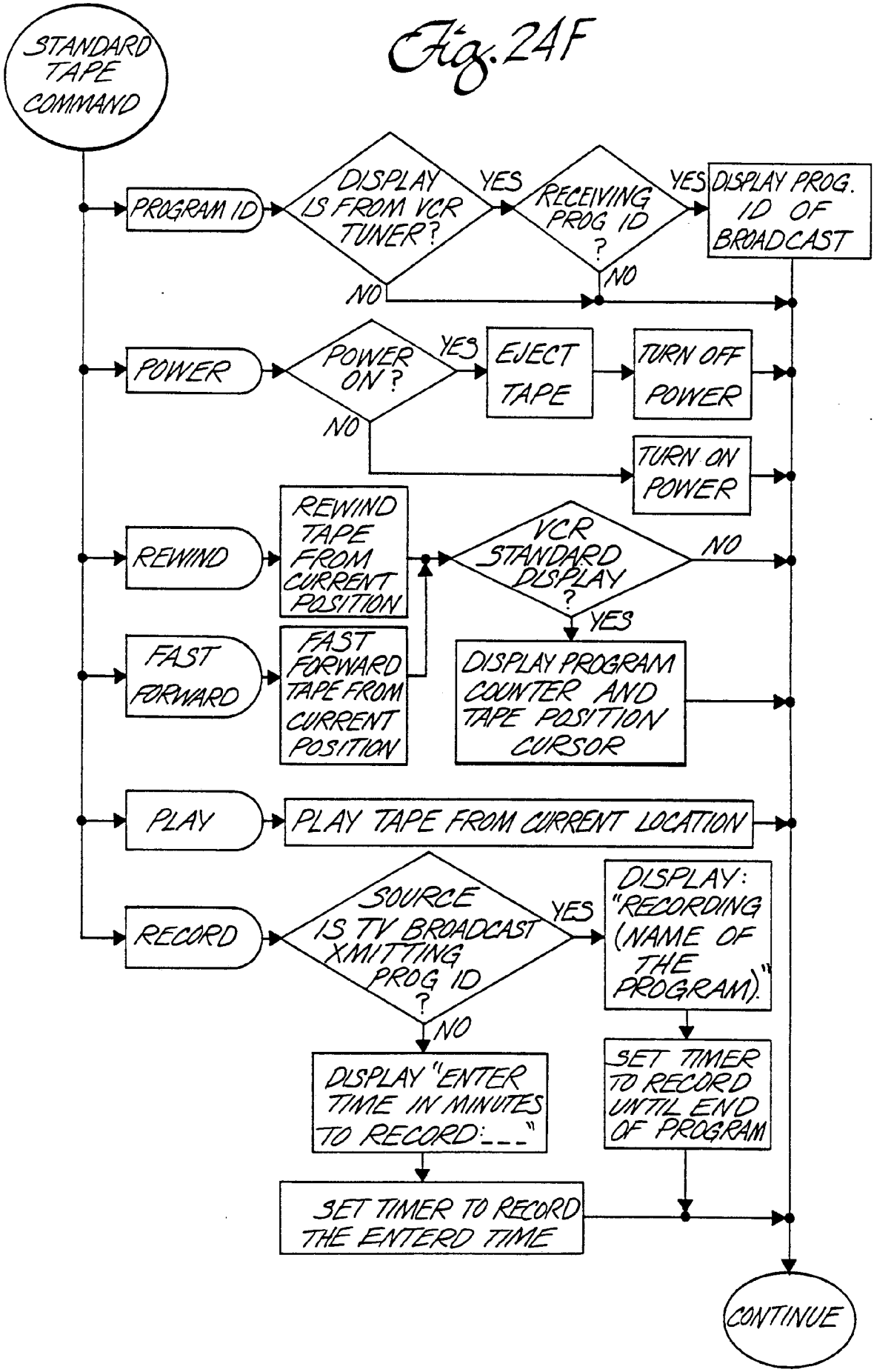

STANDARD TAPE COMMAND
PROGRAM ID
DISPLAY IS FROM VCR TUNER?
YES
RECEIVING PROG ID ?
YES
DISPLAY PROG. ID OF BROADCAST
NO
NO
POWER
POWER ON ?
YES
EJECT TAPE
TURN OFF POWER
NO
TURN ON POWER
REWIND
REWIND TAPE FROM CURRENT POSITION
VCR STANDARD DISPLAY ?
NO
YES
FAST FORWARD
FAST FORWARD TAPE FROM CURRENT POSITION
DISPLAY PROGRAM COUNTER AND TAPE POSITION CURSOR
PLAY
PLAY TAPE FROM CURRENT LOCATION
RECORD
SOURCE IS TV BROADCAST XMITTING PROG ID ?
YES
DISPLAY: "RECORDING (NAME OF THE PROGRAM)."
NO
SET TIMER TO RECORD UNTIL END OF PROGRAM
DISPLAY "ENTER TIME IN MINUTES TO RECORD:___"
SET TIMER TO RECORD THE ENTERD TIME
CONTINUE

Fig. 24G

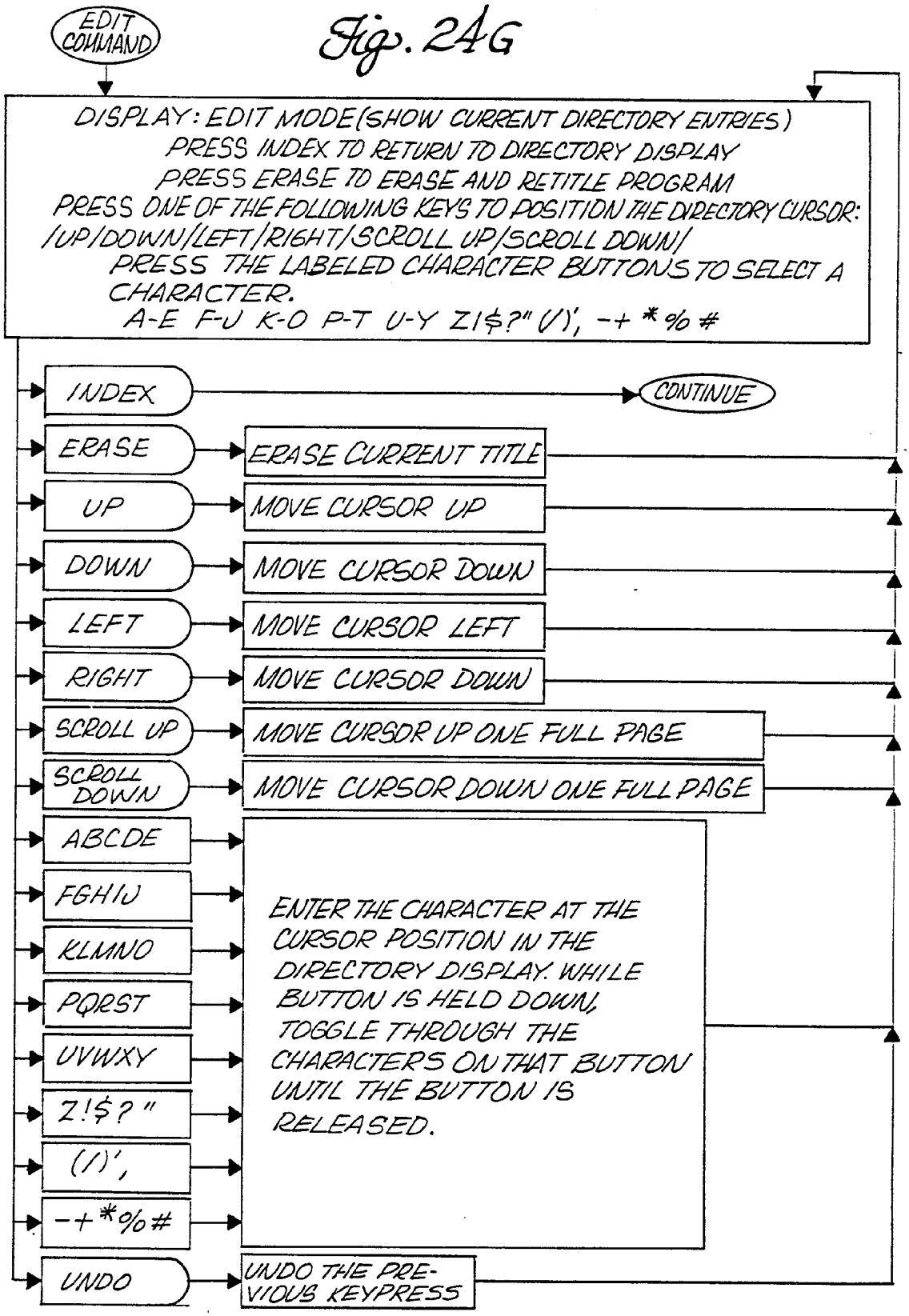

EDIT COMMAND
DISPLAY: EDIT MODE (SHOW CURRENT DIRECTORY ENTRIES)
PRESS INDEX TO RETURN TO DIRECTORY DISPLAY
PRESS ERASE TO ERASE AND RETITLE PROGRAM
PRESS ONE OF THE FOLLOWING KEYS TO POSITION THE DIRECTORY CURSOR:
/UP/DOWN/LEFT/RIGHT/SCROLL UP/SCROLL DOWN/
PRESS THE LABELED CHARACTER BUTTONS TO SELECT A CHARACTER.
A-E F-U K-O P-T U-Y Z!$?" (/)', -+ * % #
INDEX
CONTINUE
ERASE
ERASE CURRENT TITLE
UP
MOVE CURSOR UP
DOWN
MOVE CURSOR DOWN
LEFT
MOVE CURSOR LEFT
RIGHT
MOVE CURSOR DOWN
SCROLL UP
MOVE CURSOR UP ONE FULL PAGE
SCROLL DOWN
MOVE CURSOR DOWN ONE FULL PAGE
ABCDE
FGHIJ
KLMNO
PQRST
UVWXY
Z!$?"
(/)',
-+*%#
ENTER THE CHARACTER AT THE CURSOR POSITION IN THE DIRECTORY DISPLAY. WHILE BUTTON IS HELD DOWN, TOGGLE THROUGH THE CHARACTERS ON THAT BUTTON UNTIL THE BUTTON IS RELEASED.
UNDO
UNDO THE PREVIOUS KEYPRESS

Fig. 25a

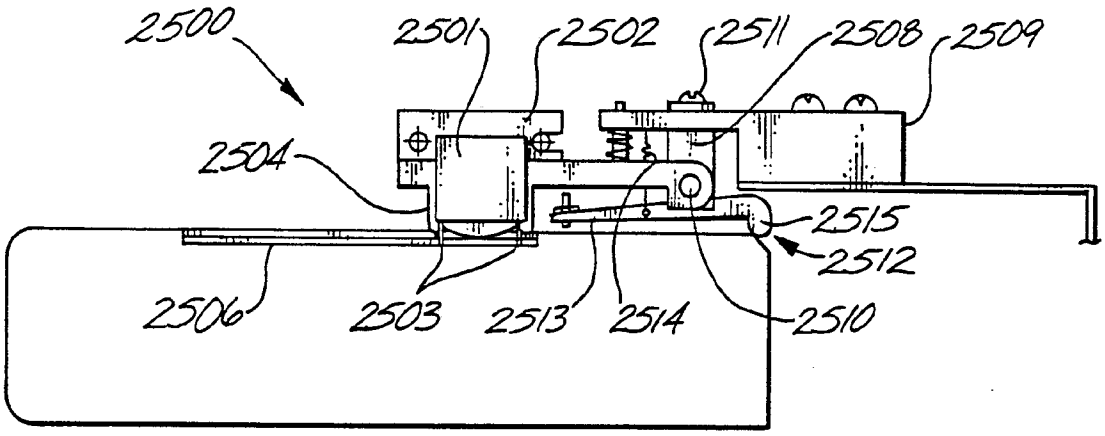


Fig. 25B